Appendix A
Miscellaneous work

In this chapter, the work on ZnO nanorods based electrodes has been discussed for hydrogen evolution and storage. These studies suggest the possibility of ZnO nanorods as hydrogen storage media in alkaline conditions.

A.1 ZnO NANOROD ELECTRODES FOR HYDROGEN EVOLUTION AND STORAGE

The molecular hydrogen (H_2) has been investigated intensively as an alternative to the fossil fuels because of its high specific heat of combustion. The hydrogen fuel cells may offer particular advantages for transportation because of its reduced weight, superior energy conversion efficiency and ecological friendliness [Veziroglu and Barbir, 1995]. Energy-efficient hydrogen production and safe storage remains the key technological obstacle for H_2 based economy. The steam reforming of hydrocarbons is used for large scale H_2 production. However, this process is not economical and also the produced hydrogen is not pure enough to use directly for an application. In contrast, electrolysis of water has been used to produce relatively pure and economical hydrogen which can be used directly in fuel cells. Also, this hydrogen is free from carbon monoxide, usually present in steam reforming process and is detrimental to the proton exchange membrane of fuel cells [Rossmeisl *et al.*, 2007]. In the hydrogen evolution reaction (HER) [Roberge, 2008], Iron (Fe) and Ni (nickel) electrodes are used because of their relatively high H_2 evolution overpotentials (380 and 480 mV, respectively). In spite of high overpotentials, the process is energy intensive and consumes huge electricity [Shan *et al.*, 2008; De Giz *et al.*, 1995; Wang *et al.*, 2005; Arul, 2000; Qing *et al.*, 2003, 2004; de Souza Roberto *et al.*, 2007; Joanna and Antoni, 2007]. In recent years, numerous studies have focused, on the quest for new electrode materials presenting higher electrocatalytic efficiency for HER [Rosalbino *et al.*, 2005; Metikos-Hukovic *et al.*, 2006; Hu, 2000]. Many semiconductor oxides, such as TiO_2, WO_3, ZnO, $SrTiO_3$, Fe_2O_3, Cu_2O, SiO_2, etc., have been tested (in both bulk and nano form), for such applications [Satsangia Vibha *et al.*, 2008; Bjorksten *et al.*, 1994; Zaban *et al.*, 2000; Aroutiounian *et al.*, 2005; Rau Greg, 2004; El-Meligi and Ismail 2009]. There are few studies on the oxidation activities on ZnO as well as the ability of ZnO nanorods (NRs) to store the hydrogen [Cox *et al.*, 2001; Cox *et al.*, 2001; Hofmann *et al.*, 2002; Ip *et al.*, 2003; Kılıç and Zunger, 2002; Lee *et al.*, 2006; Van de Walle, 2002; Van De Walle, 2001; Van De Walle CG, 2000]. ZnO has also been investigated for photocatalytic anodes in solar-powered photo-electro-chemical (PEC) electrolysis, where H_2 is generated directly by using a metal cathode and a semiconducting anode for water splitting [Yan *et al.*, 2007; Wolcott *et al.*, 2009]. In this section, we will discuss the HER electrocatalytic efficiency and the hydrogen storage capability of high quality PLD-grown ZnO NRs on Si (100) substrates (ZnO NR /Si (100)) in both acid and alkaline electrolytes.

A.1.1 Experimental Details

Vertical arrays of self-forming, catalyst-free, ZnO NRs were grown on Si (100) substrates using Pulsed Laser Deposition (PLD), by Rogers et al and reported in details elsewhere [Rogers *et al.*, 2011]. The crystalline quality of ZnO nanostructures was investigated using X-Ray Diffraction (XRD) measurements, performed in a Panalytical MRD Pro system using a Cu K_α source, a four-bounce Ge monochromator in the incident beam path and a "triple-axis" monochromator in the diffracted beam path. Sample morphology was studied using a Hitachi

S4800 Field Emission-Scanning Electron Microscope (FE-SEM). The room temperature Photo Luminescence (PL) measurement was carried out using 325 nm HeCd laser emission line. Electrochemical studies were made using ZnO (NR)/Si (100) as the cathode (working electrode), a platinum wire as the anode and Ag/AgCl as a reference electrode. Electrical connections were made to the ZnO NR/Si (100) by soldering a copper wire to the Si. The fabricated electrochemical cells were tested using both 1M H_2SO_4 acidic and 8.5M KOH alkaline electrolytes. All cyclic voltammetry measurements are conducted using an Iviumstat spectro-electro-chemical workstation in the three electrode assembly (details are discussed in section 3.3.10.1).

A.1.2 Results and Discussion

The X-ray diffraction measurements were collected in 2θ/Ω and Ω scans and results are shown in Figure A.1. The broadened multi-peak diffraction at 2θ ~ 34.47° suggests that the lattice parameter 'c' has increased from ~ 5.192 Å to ~ 5.200 Å. There is also some higher-angle broadening at the base of the peak, as shown in Figure A.1a, suggesting the contribution from smaller c lattice parameters as well. The disorders in these nanostructures, especially for the less dense a-b plane at the base of the NRs (and thus a larger lattice parameter 'a') may be the main reason for the observed large variation in the lattice parameters [Sandana *et al.*, 2011]. The Ω scan measurement is also shown in Figure A.1b which is symmetrical with a Full-Width Half Maximum (FWHM) of 0.47°. These measurements explain that NRs are highly c-axis oriented.

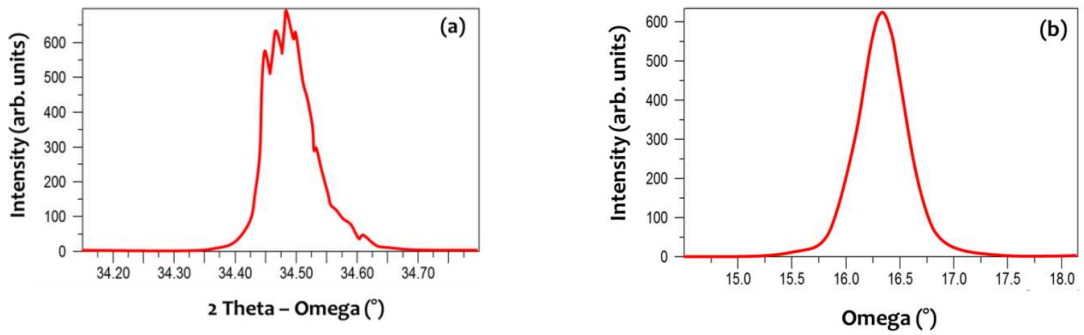


Figure A.1 : XRD **(a)** 2θ/Ω and **(b)** Ω scans for the (0002) peak of the ZnO NRs grown on Si (100).

Figure A.2(a) shows an FE-SEM image of the top surface of ZnO NRs on Si substrate. These rods are vertically aligned with diameters ranging from 100 nm to 300 nm, and a pitch of about 400 nm. The rods lengths were varied in between ~ 1 μm to ~ 2 μm by controlling the growth parameters. The room temperature photoluminescence spectrum for the ZnO NRs on Si (100) substrate is shown in Figure A.2(b). Strong main emission peaked at 3.176 eV, corresponds to the wurtzite ZnO near band edge emission (NBE), with FWHM about 110 meV. The additional peak at 3.3eV, has been observed, as shoulder peak and may correspond to the oxygen defects, especially oxygen vacancies consistent with the reported literature [Tam *et al.*, 2006; Wu and Liu, 2002].

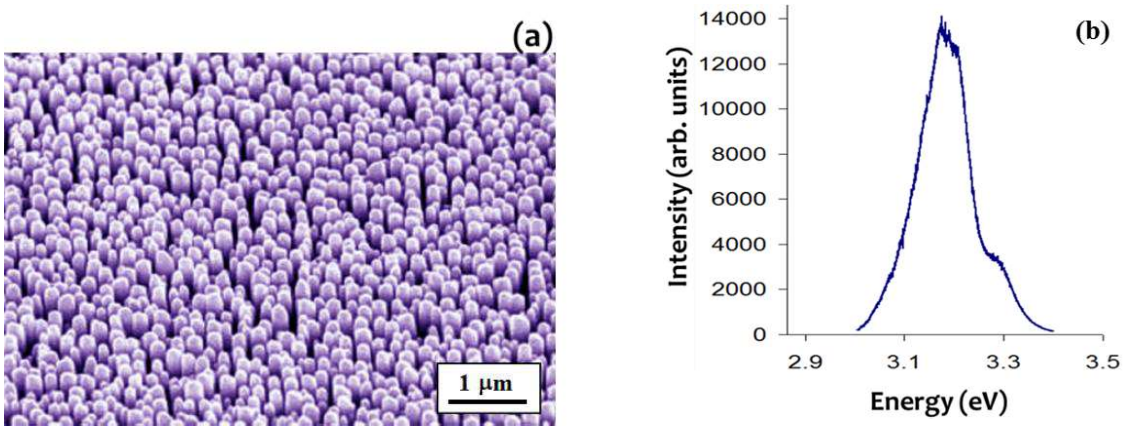


Figure A.2 : (a) FE-SEM image of vertical ZnO nanorod array grown by PLD on a Si (100) substrate. **(b)** Room temperature photoluminescence spectrum for the ZnO NR grown on Si (100).

The cyclic voltammetry plots for ZnO NRs/Si (100) in 1M H_2SO_4 and 8.5 M KOH are shown in Figures A.3 (a & b). These observations suggest that H_2 evolution is irreversible in acidic, whereas reversible in basic conditions.

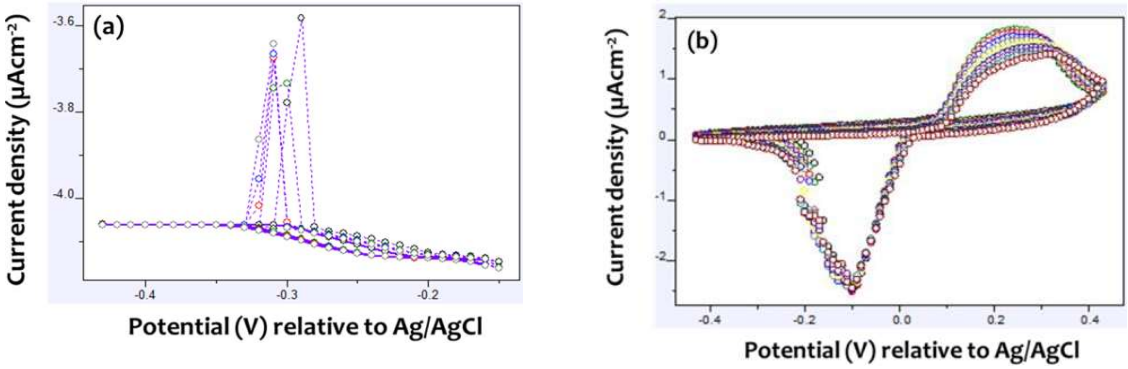


Figure A.3 : (a) Cyclic Voltammetry plots for a ZnO NR/Si (100) working electrode in 1M H_2SO_4 at a 10mV/s scan rate for five cycles. **(b)** Cyclic voltammetry plots for a ZnO NR / Si (100) working electrode in 8.5M KOH at 10mV/s scan rate for five cycles.

Figure A.3 (a) show the irreversible nature of the voltammogram. To understand the hydrogen evolution reaction (HER) in an acidic electrolyte, three reactions mechanism are considered such as Volmer (electrosorption), Heyrovsky (electrodesorption) and Tafel (recombination) mechanisms [Harrington and Conway, 1987]. The electron transfer process for each mechanism is summarized in Table A.1 for acidic medium. Considering the similar possibility at the surface of ZnO NRs (Table A.1), hydrogen may form and escape through the solution, and that's why there is no reversible process in these voltammogram. It could also be possible that the generated H_2 may get trapped in the ZnO NRs due to Van der Waal's forces. The slight agitation would then be likely to release this physisorbed H_2.

Table A.1 : Mechanism of H_2 evolution in acidic medium

Mechanism	Metal Surface	ZnO Surface
Volmer	$H_3O^+ + e^- + M \rightarrow MH + H_2O$	$H_3O^+ + e^- \rightarrow ZnO....H + H_2O$
Heyrovsky	$H_3O^+ + e^- + MH \rightarrow M + H_2$	$H_3O^+ + e^- + ZnO...H \rightarrow ZnO + H_2O$
Tafel	$2MH \rightarrow 2M + H_2$	$2ZnO...H \rightarrow 2ZnO + H_2$

Hydrogen evolution mechanism in the alkaline medium on both metal surface and ZnO surface are given in Table A.2 for the three possible mechanisms. The hydrogen evolution reaction is reversible and reproducible under alkaline conditions. The measured reversible cyclic voltammograms are shown Figure A.3b.

Table A.2 : Mechanism of H_2 evolution in basic medium

Mechanism	Metal Surface	ZnO Surface
Volmer	$H_3O^+ + e^- + M \rightarrow MH_{ads} + OH^-$	$H_2O + e^- + ZnO \rightarrow ZnO...H + OH^-$
Heyrovsky	$MH_{ads} + e^- + H_2O \rightarrow M + OH^- + H_2\uparrow$	$ZnO...H + e^- + H_2O \rightarrow H_2\uparrow + ZnO + OH^-$
Tafel	$MH_{ads} \rightarrow 2H + H_2\uparrow$	$2ZnO...H \rightarrow 2ZnO + H_2\uparrow$

If out of these three steps, Heyrovsky electrochemical desorption step becomes the rate-determining step (RDS) (i.e. evolution of H_2 from ZnO surface is the RDS), the resident time that an H atom is hydrogen-bonded to the O of ZnO will increase and hence the cathodic peak will be smaller and broader. During the anodic cycle the peak current increases and a shift in peak potential between cathodic and anodic peaks is observed, ΔE_{shift} = 0.15 V. This shift can be attributed to the existence of ZnO-H species after a cathodic sweep and evolution of H_2 is occurring in anodic sweep via recombination of ZnO-H rather than electrochemical desorption. This hypothesis is consistent with the high electronegativity of O, which would assist to hold the H atom strongly in ZnO lattice via hydrogen bonding. When an anodic potential is applied afterwards, the bonded H would start recombining with neighboring H species, bound to ZnO and thus promote the evolution of H_2.

A phenomenological thermodynamic analysis can be carried out for the above HER mechanisms of ZnO NRs surfaces in (i) an acidic and (ii) an alkaline medium to obtain the energy required for the reaction to proceed (the activation energy, ΔG_{eq}), as well as to investigate the energies of each process occurring during the reaction.

Case (i) Acidic medium

The standard exchange current density for HER on s, p and d metal surfaces ($i_{0(HER)}$) can be written as [Harinipriya and Sangaranarayanan, 2002]

$$i_{0(HER)} = \left(\frac{FC_H + k_b T}{Ah} \right) \exp\left\{ -\frac{\Delta G_{H^+-s}}{2SN_{H^+}RT} - \frac{F\chi_e^s}{2RT} + \frac{F\xi\Phi_M}{RT} \right\}, \quad \text{(A.1)}$$

where F is faraday constant in C/mol, C_{H^+} represent the concentration of H^+ ions in mol/liter, k_b denote Boltzmann constant in J/K, T is the ambient temperature in K, A indicates the area of the electrode in cm^{-2}, h is the Planck's constant in Js, ΔG_{H^+-s} is the hydration energy of H^+ ions in J/mol, SN_{H^+} is the hydration number of H^+ ions, R is the Gas constant in J/K/mol, χ_e^s being the surface potential of electrons (excess energy required for the electrons to cross solution/electrode interface and vice versa) in eV, ξ is a dimensionless constant and Φ_M is the workfunction of the electrode (in eV) under consideration. The free energy of activation (ΔG_{eq}(HER) (eV)) and heterogeneous rate constant are explained elsewhere [Harinipriya and Sangaranarayanan, 2002]. ξ = 0.17, irrespective of the cathode material. The free energy of the solution for protons (protonium ion, ΔG_{H^+-s} (eV)) and the electron surface potential in solution (χ_e^s (eV)), are reported as 9.357 eV and 0.4 eV, respectively [Trasatti, 1976, 1972a; Marcus, 1991]. The hydration number (SN_{H^+}) is given as 5 and from Figure A.3a, peak current density for the HER on the ZnO NRs in 1M H_2SO_4 is -3.7 μAcm^{-2}

(ii) Alkaline medium

The free energy of activation and heterogeneous rate constant are represented in details of published work [Harinipriya *et al.*, 2012]. The exchange current density can be given as,

$$i_0 = \frac{nFC_{OH} - k_b T}{Ah} \exp\left\{ -\frac{(1+\beta)E^0_{red,\frac{H^+}{H_2}}}{RT} + \frac{\Delta G^{form}_{mH}}{RT} - \frac{\Delta G^{form}_{H-H}}{RT} + \frac{pH\beta nF}{RT} \right\}, \quad \text{(A.2)}$$

where β = 0.5 is the symmetry factor of the reaction, $E^0_{red,\frac{H^+}{H_2}}$ is the standard reduction potential of H^+ to H_2. From the above expression for $i_{0(HER)}$, the actual free energy change involved in the storage of H atoms in ZnO NRs can be evaluated from electrochemical data. From Figure A.3b, if the anodic peak current is considered to be responsible for the recombination of ZnO…H species leading to hydrogen evolution, then $i_{0(HER)}$ is taken to be 2.5 μAcm^{-2}. Upon substituting C_{OH^-} as 8.5, pH as 15, ΔG^{form}_{H-H} and $E^0_{red,\frac{H^+}{H_2}}$ are reported as 4.518 eV and 0.245 V [Lide, 1987] with respect to the Ag/AgCl electrode. The free energy change involved in the bonding of hydrogen to ZnO as ZnO…H (ΔG^{form}_{mH}) is calculated using equation (A.2) and is ~192.086kJ/mol (this value is approximately three times higher than the O-H…O type hydrogen bonding in water) [Vinogradov and Linnel, 1971].

A.2 CONCLUDING REMARKS

Vertically arrays of nanorods with preferential c-axis orientation of ZnO were grown on the native oxide on the surface of Si (100) substrates with strong NBE emission peaked at 3.176 eV. Cyclic voltammetry analysis indicated that H can be stored in ZnO NRs via formation of ZnO-H bonding in a strongly alkaline medium.

…

Annexure B

MATLAB Program for Absorptance and Emittance Calculation

B.1 ABSORPTANCE CALCULATION

```
        % Caution: before running the program, kindly load data file having first
% column as Lambda (λ) values, second as 1-R (Lambda) and third as a reference
%******************Input Data reading*******************************%
Lambda=data(:,1);
R=data(:,2);  % R represents (1-R(Lambda))
I=data(:,3);
n=size(Lambda);
Numerator=zeros(1,n(1));
for i=1:n(1)
   Numerator(i)=R(i)*I(i);         % generates complete numerator column
  end
A=trapz(Lamda, Numerator) % Numerical integration of numerator of absorptance expression
B=trapz(Lamda, I)      % Numerical integration of denominator of absorptance expression
absorbance=A/B            % final absorptance value
```

B.2 EMITTANCE CALCULATION

```
        % Caution: before running the program, kindly load data file having first
% column as Lambda values and second as R (Lambda)
%******************Input Data reading*******************************%
L=data(:,1);
Lambda=L*1e-6;
R=data(:,2);
n=size(Lambda);
T=300;
c1=3.743e-16;
c2=0.0143879;
Eb=zeros(1,n(1));
Numerator=zeros(1,n(1));
for i=1:n(1)
   Eb(i)=c1/((Lambda(i))^5*(exp(c2/(Lambda(i)*T))-1)); % generates Eb data column
   Numerator(i)=(1-R(i))*Eb(i);                  % generates complete numerator column
  end
A=trapz(Lambda, Numerator) % Numerical integration of numerator of emittance expression
B=trapz(Lambda, Eb)       % Numerical integration of denominator of emittance expression
epsilon=A/B               % final emittance value
```

…

Publications

PATENTS

Indian Patent

- Title: A Black Chromium Coating Bath
- Appl. No. : 1433/DEL/2013

US Patent

- Title: Ink Composition
- Pub. No. : US 2014/036917 A1

International Journal

B. Usmani, V. Vijay, R. Chhibber, A. Dixit, "Optimization of sputtered zirconium films infrared reflector in spectrally selective solar absorbers", ***Journal of Thin Solid Films,*** doi: 10.1016/j.tsf.2017.02.055.

B. Usmani, V. Vijay, R. Chhibber, A. Dixit, "Investigation of ZrO_x/ZrC-ZrN/Zr thin film structural evolution and their degradation using X-ray diffraction and Raman spectrometry", ***Appl. Phys. A*** (2016) 122:992. DOI 10.1007/s00339-016-0523-8.

S. Harinipriya and **Belal Usmani**, "Structural and Optical behavior of electrodeposited black chrome-graphite encapsulated FeCo nanoparticles composite coatings", ***Int. J. Energy Res. (2016)*** *© 2016 John Wiley & Sons, Ltd. DOI: 10.1002/er.3669.*

B. Usmani, A. Dixit, "Impact of corrosion on microstructure and mechanical properties of ZrO_x/ZrC-ZrN/Zr absorber-reflector tandem solar selective structures", ***Solar Energy Materials and Solar Cells***, Vol. 157, (2016), 733-741.

B. Usmani, A. Dixit, "Spectrally selective response of ZrO_x/ZrC-ZrN/Zr absorber-reflector tandem structures on stainless steel and copper substrates for high temperature solar thermal applications", ***Solar Energy***, Vol. 134 (2016), 353-365.

B. Usmani, S. Harinipriya, N. Kumar, V. Gupta, Solar Selective Coatings with Enhanced Thermal and Corrosion Stability: Electrochemically Deposited Black Chrome on Stainless Steel in the Presence of Graphite Encapsulated FeCo Nanoparticles, ***Advanced Materials Research*** ,Vols. 875-877, (2014), pp. 388-393.

S. Manda, A. Saini, S. Khaleeq, R. Patel, **B. Usmani,** S. Harinipriya, B. Pratiher, B. Roy, "Thermocells of carbon material electrodes and its performance characteristics", ***j mater res technol.***, 2(2), (2013), pp. 165–181.

B. Usmani and S. Harinipriya, Characterization of black chrome films in the presence and absence of graphite encapsulated FeCo nanoparticles prepared by electrodeposition technique for solar thermal applications, ***ECS Transactions***, 53 (19), (2013), pp. 47-61.

Conference with Proceeding

S. Harinipriya and **B. Usmani**., "Ni/SiC Composite Coating on Graphite– Geometry Effect on the Coatings", Presented in PRiME, 230th ECS Meeting, October 2-7, 2016

B. Usmani, V. Vijay, R. Chhibber, A. Dixit, "Effect of Growth Condition on Mechanical Properties of Zirconium-Carbonitride Absorber Based Spectrally Selective Coatings", ***Springer Proceedings***, (In Press), 2016

B. Usmani, V. Vijay, R. Chhibber, L. Chandra, A. Dixit, "Zirconium carbide-nitride composite matrix based solar absorber structures on glass and aluminum substrates for solar thermal applications", ***International Solar Energy Society (ISES) Procedia,*** doi:10.18086/swc.2015.04.02 Available at http://proceedings.ises.org.

B. Usmani, V. Vijay, R. Chhibber, A. Dixit, "Solar Performance Analysis of ZrO_x/ZrC-ZrN/Zr/SS Spectrally Selective Coating under Extreme Thermal Environment" *Springer Proceedings* (In Press), 2016

Rajesh Kumar, Ajoy K. Saha, **Belal Usmani** and Ambesh Dixit, "Optimization and structure-property correlation of black chrome solar selective coating on Copper and Nickel plated copper substrates, ***Materials Today Proceedings*** (In Press), 2016

A. K. Saha, R. Kumar, **B. Usmani**, L. Chandra and A. Dixit, "Development of Fe_3O_4 Based Black Iron Solar Selective Coatings for Solar Absorber Applications", ***Advanced Materials Proceedings***, Vol. 1(2), (2016), pp. 140-145.

S. Harinipriya, **B. Usmani**, D. J. Rogers, V. E. Sandana, F. Hosseini Teherani, A. Lusson, P. Bove, H.-J. Drouhin and M. Razeghi, "ZnO Nanorod Electrodes for Hydrogen Evolution & Storage", **Proc. of SPIE** Vol. 8263 82631Y-1, 2012

Conference without Proceeding

B. Usmani, V. Vijay, R. Chhibber, A. Dixit, "Microstructural degradation of FeCo(C) NPs modified black chrome spectrally selective composite coatings in 3.5% NaCl Corrosion environment", 4th Nano Today conference, Dubai, December 2015

Rajesh Kumar, **Belal Usmani** and Ambesh Dixit, "Tungsten as a High-Temperature Infrared Reflector in Spectrally Selective Coatings: Issues & Challenges", 54Th National Metallurgists' Day and 70th Annual Technical Meeting, November 11-14, 2016, Indian Institute of Technology, Kanpur, India

Book Chapter

B. Usmani and S. Harinipriya, "High-Temperature Solar Selective Coating", Springer India 2015, V. Vijay et al. (eds.), Systems Thinking Approach for Social Problems, Lecture Notes in Electrical Engineering 327, DOI 10.1007/978-81-322-2141-8_15

Anurag, P. Kapoor, **B. Usmani** and S. Harinipriya, "Performance Analysis of IOCL Rawara Photovoltaic Plant and Interpretation", V. Vijay et al. (eds.), Systems Thinking Approach for Social Problems, Lecture Notes in Electrical Engineering 327, DOI 10.1007/978-81-322-2141-8_16

…

References

Abdmouleh, Z., Alammari, R.A.M., Gastli, A., (2015), "Review of policies encouraging renewable energy integration and best practices", *Renewable and Sustainable Energy Reviews,* Vol. 45, pp. 249-262, 2015

Aman, M.M., Solangi, K.H., Hossain, M.S., Badarudin, A., Jasmon, G.B., Mokhlis, H., BaKar, A.H.A., Kazi, S.N., (2015), "A review of Safety, Health and Environmental (SHE) issues of solar energy system", *Renewable and Sustainable Energy Reviews,* Vol. 41, pp. 1190-1204, 2015

Agnihotri, O.P., and Gupta, B.K., (1981), "Solar Selective Surfaces", John Wiley and Sons Inc., New York, USA, 1981

Amri, A., Jiang, Z.T., Pryor, T., Yin, C.-Y., Djordjevic, S., (2014), "Developments in the synthesis of flat plate solar selective absorber materials via sol-gel methods: A review", *Renewable and Sustainable Energy Reviews*, Vol. 36, pp. 316-328, 2014

Atkinson, C., Sansom, C.L., Almond, H.J., Shaw, C.P., (2015), "Coatings for concentrating solar system – A review", *Renewable and Sustainable Energy Review,* Vol. 45, pp. 113-122, 2015

Andersson, A., Hunderi, O., Granqvist, C.G., (1980), "Nickel pigmented anodic aluminum oxide for selective absorption of solar energy", Vol. 51, pp.754-794, 1980

Axelbaum, R.L., & Brandt, H., (1987), "The effect of substrate surface preparation on the optical properties of a black chrome solar absorber coating", *Solar Energy*, Vol. 39(3), pp. 233–241, 1987

Anandan, C., William Grips, V.K., Rajam, K.S., Jayaram, V., & Bera, P., (2002), "Investigation of surface composition of electrodeposited black chrome coatings by X-ray photoelectron spectroscopy", *Applied Surface Science*, Vol. 191, pp. 254–260, 2002

Antonaia, A., Castaldo, A., Addonizio, M. L., & Esposito, S., (2010), "Stability of W-Al_2O_3 cermet based solar coating for receiver tube operating at high temperature", *Solar Energy Materials and Solar Cells*, Vol. 94, pp. 1604–1611, 2010

Abendroth, T., Althues, H., Mäder, G., Härtel, P., Kaskel, S., & Beyer, E., (2015), "Selective absorption of Carbon Nanotube thin films for solar energy applications", *Solar Energy Materials and Solar Cells*, Vol. 143, pp. 553–556, 2015

Al-Kuhaili, M.F., & Durrani, S.M.A., (2007), "Optical properties of chromium oxide thin films deposited by electron-beam evaporation", *Optical Materials*, Vol. 29, pp. 709–713, 2007

Ali, M.R., Nishikata, A., & Tsuru, T., (1997), "Electrodeposition of aluminum-chromium alloys from $AlCl_3$-BPC melt and its corrosion and high temperature oxidation behaviors", *Electrochimica Acta*, Vol. 42, pp. 2347–2354, 1997

Abbott, A.P., Capper, G., Davies, D.L., and Rasheed, R.K., (2004), "Ionic liquid analogues formed from hydrated metal salts", *Chem. Eur. J.* Vol. 10, pp. 3769-3774, 2004

Aydoğdu, G.H., Aydinol, M.K., (2006), "Determination of susceptibility to intergranular corrosion and electrochemical reactivation behaviour of AISI 316L type stainless steel", *Corros. Sci.*, Vol. 48, pp. 3565–3583, 2006

Alanyani, H., Souto, R.M., (2003), "Research on the corrosion behavior of TiN–TiAlN multilayer coatings deposited by cathodic-arc ion plating", *Corrosion*, Vol. 59, pp. 851–854, 2003

Arul, R.I., (2000), "Nickel-based, binary-composite eletrocatalysts for the cathodes in the energy- efficient industrial production of hydrogen from alkaline water electrolytic cells", *Journal of Applied Electrochemistry,* Vol. 30, pp. 499–504, 2000

Aroutiounian, V.M., Arakelyan, V.M., Shahnazaryan, G.E., (2005), "Metal oxide photoelectrodes for hydrogen generation using solar radiation-driven water splitting", *Solar Energy*, Vol. 78, pp. 581, 2005

Barshilia, H.C., Selvakumar, N., and Rajam, S., (2006), "TiAlN/TiAlON/Si_3N_4 tandem absorber for high temperature solar selective applications", *Applied Physics Letters*, Vol. 89, pp. 19190-1, 2006

Boffey, P.M., (1970), "Energy crisis: Environmental issue Exacerbates Power Supply Problem", *Science*, Vol. 168, pp.1554-1559, 1970

Bogaerts, W.F., Lampart, C.M., (1983), "Review: materials for photothermal solar energy conversion", *Journal of Materials Science*, Vol. 18, pp. 2847-2875, 1983

Barshilia, H.C., Selvakumar, N., Rajam, K.S., Sridhara Rao, D.V., Muraleedharan, K., (2008), " Deposition and characterization of TiAlN/TiAlON/Si_3N_4 tandem absorbers prepared using reactive direct current magnetron sputtering", *Thin Solid Films*, Vol. 516, pp. 6071-6078, 2008

Brunold, S., Frei, U., Carlsson, B., Moller, K., and Kohl, M., (2000), "Accelerated life testing of solar absorber coatings: testing procedure and results", *Solar Energy*, Vol. 68, pp. 313-323, 2000

Boffey, P.M., (1970), "Energy crisis: Environmental issue Exacerbates Power Supply Problem", *Science*, Vol. 168, pp.1554-1559, 1970

Blain. J., LeBel, C., Jacques, S., and Rheault, F., (1985), "Spectrally selective surface of Co-pigmented anodic Al_2O_3", *Journal of Applied Physics*, Vol. 58, pp. 490-494, 1985

Boffey, P.M., "Energy crisis: Environmental issue Exacerbates Power Supply Problem", *Science*, Vol. 168, pp.1554-1559, 1970

Borzoni, J.t., (1976), "AES coatings for Solar Collector Symp.", *Atlanta GA*, pp.89, 1976

Bhowmik, N.C., Rahman, J., Khan, M.A.A., and Mazumder, Z.H., (2001), "Preparation of selective surfaces and determination of optimum thickness for maximum selectivity", *Renewable Energy*, Vol. 24, pp. 663–666, 2001

Boström, T., Wäckelgård, E., & Westin, G., (2003), "Solution-chemical derived nickel-alumina coatings for thermal solar absorbers", *Solar Energy*, Vol. 74, pp.497–503, 2003

Brunold, S., Frei, U., Carlsson, B., Möller, K., & Köhl, M., (2000), "Accelerated life testing of solar absorber coatings: testing procedure and results", *Solar Energy*, Vol. 68, pp. 313–323, 2000

Bayati, M.R., Shariat, M.H., & Janghorban, K., (2005), "Design of chemical composition and optimum working conditions for trivalent black chromium electroplating bath used for solar thermal collectors", *Renewable Energy*, Vol. 30, pp. 2163–2178, 2005

Boström, T.K., Wäckelgård, E., & Westin, G., (2004), "Anti-reflection coatings for solution-chemically derived nickel - Alumina solar absorbers", *Solar Energy Materials and Solar Cells*, Vol. 84, pp. 183–191, 2004

Blain, J., LeBel, C., Saint-Jacques, R.G., & Rheault, F., (1985), "Spectrally selective surfaces of Co-pigmented anodic Al2O3", *Journal of Applied Physics*, Vol. 58, pp. 490, 1985

Barshilia, H.C., Selvakumar, N., Rajam, K.S., & Biswas, A., (2008), "Structure and optical properties of pulsed sputter deposited Cr_xO_y/Cr/Cr_2O_3 solar selective coatings", *Journal of Applied Physics*, Vol. 103, pp. 023507, 2008

Barshilia, H.C., Kumar, P., Rajam, K.S., & Biswas, A., (2011), "Structure and optical properties of Ag–Al_2O_3 nanocermet solar selective coatings prepared using unbalanced magnetron sputtering", *Solar Energy Materials and Solar Cells*, Vol. 95, pp. 1707–1715, (2011)

Barshilia, H.C., Selvakumar, N., Rajam, K.S., Sridhara Rao, D.V., Muraleedharan, K., & Biswas, A., (2006), "TiAlN/TiAlON/Si_3N_4 tandem absorber for high temperature solar selective applications", *Applied Physics Letters*, Vol. 89, pp. 191909, 2006

Booth, D.C., Allred, D.D., & Seraphin, B.O., (1979), "Stabilized CVD amorphous silicon for high temperature photothermal solar energy conversion", *Solar Energy Materials*, Vol. 2, pp. 107–124, 1979

Blickensderfer, R., Deardorff, D., & Lincoln, R., (1978), "Spectrally selective solar absorbers", US Patent, 4098956, 1978

Brett, M.J., Parsons, R.R., and Baltes, H.P., (1986), "Zinc oxide multilayers for solar sollectro coatings", *Applied Optics*, Vol. 25, pp. 2712-2714, 1986

Blanc, P., Espinar, B., Geuder, N., Gueymard, C., Meyer, R., Pitz-Paal, R., Reinhardt, B., Renne, D., Sengupta, M., Wald, L., Wilbert, S., (2014), "Direct normal irradiance related definitions and applications: The circumsolar issue", *Solar Energy*, Vol. 110, pp. 561–577, 2014

Butt, H.J., Cappella, B., & Kappl, M., (2005), "Force measurements with the atomic force microscope: Technique, interpretation and applications", *Surface Science Reports*, PP. 59, pp. 1–152, 2005

Bogaerts, W.F., & Lampert, C.M. (1983), "Materials for photothermal solar energy conversion", *Journal of Materials Science*, Vol. 18 , pp. 2847–2875, 1983

Barshilia, H.C., (2014), "Growth, characterization and performance evaluation Ti/AlTiAlTiNON/AlTiO high temperature spectrally selective coatings for solar thermal power applications", *Solar Energy Materials and Solar Cells*, Vol. 130, pp. 322–330, 2014

Bilgin, V., Kose, S., Atay, F., Akyuz, I., (2005), "The effect of substrate temperature on the structural and some physical properties of ultrasonically sprayed CdS films", *Mater. Chem. Phys.* Vol. 94 pp.103–108, 2005

Barshilia, H.C., Surya Prakash, M., Poojari, A., Rajam, K., (2004), "Corrosion behavior of nanolayered TiN/NbN multilayer coatings prepared by reactive direct current magnetron sputtering process", *Thin Solid Films,* Vol. 460, pp. 133–142, 2004

Bjorksten, U., Moser, J., Gratzel, M., (1994), "Photoelectrochemical studies on nanocrystalline hematite films", *Chemistry of Materials*, Vol.6, pp. 858, 1994

Cao, F., McEnaney, K., Chen, G., and Ren, Z., (2014), "A review of cermet-based spectrally selective solar absorbers", *Energy Environ. Sci.*, Vol. 7, pp. 1615-1627, 2014

Cheung, J.T., (1994), "History and fundamentals of pulsed laser deposition, in: Chrisey, D.B., Hubler, G.K., (Eds.), Pulsed Laser Deposition of thin Films, John Wiley, New York, 1994

Chen, B., Yang, D., Charpentier, P.A., Nikumb, S., (2008), "Optical and structural properties of pulsed deposited Ti:Al_2O_3 thin films", *Solar Energy Materials and Solar Cells,* Vol. 92, pp. 1025-1029, 2008

Crnjak Orel, Z., Leskovsek, N., Orel, B., Hutchins, M.G., (1996), "Spectrally selective silicon paint coatings: Influence of pigment volume concentration ratio on their optical properties", *Solar Energy Materials and Solar Cells*, Vol. 40, pp.197–204, 1996

Chang, C.C., Huang, C.L., & Chang, C.L., (2013), "Poly(urethane)-based solar absorber coatings containing nanogold", *Solar Energy*, Vol. 91, pp. 350–357, 2013

Cuevas, A., Martínez, L., Romero, R., Dalchiele, E.A., Marotti, R., Leinen, D., Ramos-Barrado, J.R., Martin, F., (2014), "Electrochemically grown cobalt-alumina composite layer for solar thermal selective absorbers", *Solar Energy Materials and Solar Cells*, Vol. 130, pp. 380–386, 2014

Cheng, H.Y., Chiou, J.W., Ting, J.M., & Tzeng, Y., (2013), "Reactively co-sputter deposited a-C:H/Cr thin films: Material characteristics and optical properties", *Thin Solid Films*, Vol. 529, pp. 164–168, 2013

Craighead, H.G., Howard, R.E., & Sweeney, J.E., Buhrman, R.A., (1981), "Graded-index Pt-Al_2O_3 composite solar absorbers", *Applied Physique Letters*, Vol. 39, pp. 29–31, 1981

Cheng, J., Wang, C., Wang, W., Du, X., Liu, Y., Xue, Y., Wang, T., Chen, B., (2013), "Improvement of thermal stability in the solar selective absorbing Mo–Al_2O_3 coating", *Solar Energy Materials and Solar Cells*, Vol. 109, pp. 204–208, 2013

Cao, A., Zhang, X., Xu, C., Wei, B., & Wu, D., (2002), "Tandem structure of aligned carbon nanotubes on Au and its solar thermal absorption", *Solar Energy Materials and Solar Cells*, Vol. 70, pp. 481–486, 2002

Céspedes, E., Wirz, M., Sánchez-García, J.A., Alvarez-Fraga, L., Escobar-Galindo, R., & Prieto, C., (2014), "Novel Mo–Si_3N_4 based selective coating for high temperature concentrating solar power application", *Solar Energy Materials and Solar Cells*, Vol. 122, pp. 217–225, 2014

Christie, D.J., Sproul, W.D., Carter, D.C., and Tomasel, F., (2004), "A novel Pulsed Supply with Arc Handling and Leading Edge Control as Enabling Technology for High Power Pulsed Magnetron Sputtering (HPPMS)", 47th Annual Technical Conference Proceeding of the Society of Vacuum Coaters, pp. 113-118, 2004

Cormia, R.L., Trumbley, T.A., and Andresen, S., (1977), "Method for coating a substarte", U.S. Patent 4, 046,659, 1977

Conroy, M., & Amstrong, J., (2006), "A comparison of surface metrology methods", *Optical Micro-and Nanometrology in Microsystems Technology",* PP. 6188, 2006

Chu, S.-Y., Kline, C., Huang, M.-Q., McHenry, M.E., Cross, J., & Harris, V.G., (1999), "Preparation, characterization and magnetic properties of an ordered FeCo single crystal", *Journal of Applied Physics*, Vol. 85, pp. 6031, 1999

Cullity, B.D., (1972), "Elements of X-ray Diffraction", Addison-Wesley, Reading, MA, p.102, 1972

Carel, R., (1995), "Grain growth and texture evolution in thin film, submitted to the department of materials science and engineering in partial fulfillment of the requirement for the degree of Doctor of Philosophy in material science", 1995

Chowdhury, A.K.M.S., Cameron, D.C., Hashmi, M.S.J., (1999), "Bonding structure in carbon nitride films: variation with nitrogen content and annealing temperature", *Surf. Coatings Technol.* Vol. 112, pp.133–139, 1999

Chen, C.S., Liu, C.P., Tsao, C.Y.A., Yang, H.G., (2004), "Study of mechanical properties of PVD ZrN films, deposited under positive and negative substrate bias conditions", *Scr. Mater.* Vol. 51, pp. 715–719, 2004

Craciun, D., Socol, G., Dorcioman, G., Stefan, N., Bourne, G., Craciun, V., (2010), "High quality ZrC, ZrC/ZrN and ZrC/TiN thin films grown by pulsed laser deposition", *J. Optoelectron. Adv. Mater.*, Vol, 12, pp. 461–465, 2010

Cox, S.F., Davis, E.A., Cottrell, S.P., King, P.J., Lord, J.S., Gil, J.M., et al., (2001), "Experimental confirmation of the predicted shallow donor hydrogen state in zinc oxide", *Physical Review Letters*, Vol. 86, pp. 2601–4, 2001

Cox, S.F.J., Davis, E.A., King, P.J.C., Gil, J.M., Alberto, H.V, Vilão, R.C., et al., (2001), "Shallow versus deep hydrogen states in ZnO and HgO", *Journal of Physics: Condensed Matter*, Vol. 13, pp. 9001–

9010, 2001
Duffie, J.A., and Beckman, W.A., (1991), "Solar Engineering of Thermal Processes", 2nd Edition, Wiley-Interscience, New York, USA, 1991
Dobrowolski, J.A., (1995), "Optical properties of films and coatings", Handbook of Optics, 2nd Edition, Optical Society of America, McGraw-Hill, New York, 1995
Du, M., Hao, L., Mi, J., Lv, F., Liu, X., Jiang, L., & Wang, S., (2011), "Optimization design of $Ti_{0.5}Al_{0.5}N/Ti_{0.25}Al_{0.75}N/AlN$ coating used for solar selective applications", *Solar Energy Materials and Solar Cells*, Vol. 95, pp. 1193–1196, 2011
Ding, D., Cai, W., Long, M., Wu, H., & Wu, Y., (2010), "Optical, structural and thermal characteristics of $Cu–CuAl_2O_4$ hybrids deposited in anodic aluminum oxide as selective solar absorber", *Solar Energy Materials and Solar Cells*, Vol. 94, pp. 1578–1581, 2010
Du, M., Liu, X., Hao, L., Wang, X., Mi, J., Jiang, L., & Yu, Q., (2013), "Microstructure and thermal stability of $Al/Ti_{0.5}Al_{0.5}N/Ti_{0.25}Al_{0.75}N/AlN$ solar selective coating", *Solar Energy Materials and Solar Cells*, Vol. 111, pp. 49–56, 2013
Davidse, P.D., and Maisel, L.I., (1966), "Dielectric Thin Films through rf Sputtering", *Journal of Applied Physics*, 37, pp. 574, 1966
Davidse, P.D., (1967a), "Rf sputter etching—a universal etch", *Vacuum*, Vol. 17, pp. 165, 1967
Davidse, P.D., (1967b), "Theory and practice of RF sputtering", *Vacuum*, Vol. 17, pp. 139–145, 1967
Daryabegy, M., and Mahmoodpoor, A.R., (2006), "Method of manufacturing absorbing layers on copper for solar applications (I)", *Renewable Energy Organization of Iran*, Vol. 2, pp. 35-39, (2006)
Driver, P.M., & McCormick, P.G., (1982), "Black chrome selective surfaces I. Deposit growth and properties", *Solar Energy Materials*, Vol. 6, pp. 159–173, 1982
Danilov, F.I., Protsenko, V.S., & Butyrina, T.E., (2001), "Chromium Electrodeposition Kinetics in Solutions of Cr(III) Complex Ions", *Russian Journal of Electrochemistry*, Vol. 37, pp. 704–709, 2001
Dibari, G.A, Turillon, P.P, (1979), "Effect of corrosion on selectivity of electrodeposited black chromium with and without nickel under layers", in *Sun II, Proceedings of the International Solar Energy Society Congress, Atlanta,* Vol. 3, edited by Boer, K. W; Glenn, B.H; (Pergamon, New York, 1979) p. 1917, 1979
Driver, P.M., (1981), "An electrochemical approach to the characterisation of black chrome selective surfaces", *Solar Energy Materials*, Vol. 4, pp. 179–202, 1981
Driver, P.M., Jones, R.W., Riddiford, C.L., & Simpson, R.J., (1977), "A new chrome black selective absorbing surface", *Solar Energy*, Vol. 19, pp. 301–306, 1977
Desvaux, C., Amiens, C., Fejes, P., Renaud, P., Respaud, M., Lecante, P., Snoeck, E., Chaudret, B., (2005), "Multimillimetre-large superlattices of air-stable iron-cobalt nanoparticles", *Nature Materials*, Vol. 4, pp. 750–3, 2005
De Hosson, J.T.M., Cavaleiro, A., (2006), "Galileo comes to the surface! Nanostructured Coatings, Nanostructure Science and Technology", Springer New York 2006, pp. 1–26.
de Souza Roberto, F., Padilha Janine, C., Gonc alves Reinaldo, S., de Souza Michele, O., Rault-Berthelot Joe, lle., (2007), "Electrochemical hydrogen production from water electrolysis using ionic liquid as electrolytes: towards the best device", *Journal of Power Sources*, Vol. 164, pp. 792–8, 2007
De Giz, M.J., Tremiliosi-Filho, G., Gonzalez, E.R., Srinivasan, S., Appleby, A.J., (1995), "The hydrogen evolution reaction on amorphous nickel and cobalt alloys", *International Journal of Hydrogen Energ,* Vol. 20, pp. 423–427, 1995
Dixit, A., Sudakar, C., Thakur, J.S., Padmanabhan, K., Kumar, S., Naik, R., Naik, V.M., and Lawes, G., (2009), "Strong plasmon absorption in InN thin films", *J. Appl. Phys.,* Vol. 105, pp. 053104, 2009
Eugenio, S., Rangel, C.M., Vilar, R., & do Rego, A.M., (2011), "Electrodeposition of black chromium spectrally selective coatings from a Cr(III)-ionic liquid solution", *Thin Solid Films*, Vol. 519, pp. 1845–1850, 2011
Elyasi, R., Nowee, S.M., Namaghi, H. A., & Ramezanian, N., (2015), "Preparation and characterization of absorbing tubes with spectrally selective coatings using economical methods for low- to mid-temperature solar thermal collectors", *Solar Energy Materials and Solar Cells*, Vol. 141, pp. 57–70, 2015
Esposito, S., Antonaia, A., Addonizio, M.L., & Aprea, S., (2009), "Fabrication and optimisation of highly efficient cermet-based spectrally selective coatings for high operating temperature", *Thin Solid Films*, Vol. 517, pp. 6000–6006, 2009
Echániz, T., Setién-Fernández, I., Pérez-Sáez, R.B., Prieto, C., Galindo, R.E., & Tello, M.J., (2015), "Importance of the spectral emissivity measurements at working temperature to determine the efficiency of a solar selective coating", *Solar Energy Materials and Solar Cells*, Vol. 140, pp. 249–252, 2015

Eisenhammer, T., (1995), "Quasicrystal films: numerical optimization as a solar selective absorber", *Thin Solid Films*, Vol. 270, pp. 1–5, 1995

Est, G., and Westwood, W.D., (1998), "Handbook of Thin Film Process Technology", IOP Publishing Ltd, 1998

Emslie, A.G., Bonner, F.T., & Peck, L.G., (1958), "Flow of a viscous liquid on a rotating disk", *Journal of Applied Physics*, Vol. 29, pp. 858–862, 1958

Endres, F., Bukowski, M., Hempelmann, R., & Natter, H., (2003), "Electrodeposition of nanocrystalline metals and alloys from ionic liquids", *Angewandte Chemie (International Ed. in English)*, Vol. 42, pp. 3428–30, 2003

Endres, F., MacFarlane, D.R., Abbott, A.P., (2008), "Electrodeposition from Ionic Liquids", Wiley-VCH, 2008

Endres, F., (2002), "Ionic liquids: Solvents for the electrodeposition of metals and semiconductors", *ChemPhysChem*, Vol. 3, pp. 144–154, 2002

Eugénio, S., Rangel, C.M., Vilar, R., & Botelho do Rego, A.M., (2011), "Electrodeposition of black chromium spectrally selective coatings from a Cr(III)–ionic liquid solution", *Thin Solid Films*, Vol. 519, pp. 1845–1850, 2011

El-Meligi, A.A., Ismail N., (2009), "Hydrogen evolution reaction of low carbon steel electrode in hydrochloric acid as a source for hydrogen production", *Iinternational journal of hydrogen energy,* Vol. 34, pp. 91 – 97, 2009

Fan, J.C.C., and Spura, S.A., (1977), "Selective black absorbers using rf-sputtered Cr_2O_3/Cr Cermet films," *Applied Physics Letters*, Vol. 30, pp. 511-513, 1977

Farooq, M., & Hutchins, M.G., (2002), "A novel design in composities of various materials for solar selective coatings", *Solar Energy Materials and Solar Cells*, Vol. 71, pp. 523–535, 2002

Feng, J., Zhang, S., Lu, Y., Yu, H., Kang, L., Wang, X., Liu, Z., Ding, H., Tian, Y., Ouyang, J., (2015a), "The spectral selective absorbing characteristics and thermal stability of SS/TiAlN/TiAlSiN/Si_3N_4 tandem absorber prepared by magnetron sputtering", *Solar Energy*, Vol. 111, pp. 350–356, 2015

Fan, J.C.C., & Zavracky, P. M., (1976), "Selective black absorbers using MgO/Au cermet films", *Applied Physics Letters*, Vol. 29, pp. 478, 1976

Feng, J., Zhang, S., Liu, X., Yu, H., Ding, H., Tian, Y., & Ouyang, J., (2015b), "Solar selective absorbing coatings TiN/TiSiN/SiN prepared on stainless steel substrates", *Vacuum*, Vol. 121, pp. 135–141, 2015

Farooq, M., & Raja, I.A., (2008), "Optimisation of metal sputtered and electroplated substrates for solar selective coatings", *Renewable Energy*, Vol. 33, pp. 1275–1285, 2008

Fang, T.-H., Jian, S.-R., & Chuu, D.-S., (2004), "Nanomechanical properties of TiC, TiN and TiCN thin films using scanning probe microscopy and nanoindentation", *Applied Surface Science*, Vol. 228, pp. 365–372, 2004

Flack, W.W., Soong, D.S., Bell, A.T., & Hess, D.W., (1984), "A mathematical model for spin coating of polymer resists", *Journal of Applied Physics*, Vol. 56, 1199

Fang, T.H. and Chang, W.J., (2004a), "Nanoindentation characteristics on polycarbonate polymer film", *Microelectronics Journal*, Vol. 35, pp. 595–599, 2004

Fang, T.-H., Jian, S.-R., Chuu, D.-S., (2004b), "Nanomechanical properties of TiC, TiN and TiCN thin films using scanning probe microscopy and nanoindentation", *Appl. Surf. Sci.*, Vol. 228, pp. 365–372, 2004

Fontana, M.G., (2009), "Corosion Engineering", Tata McGraw Hill Education Private Limited, New Delhi, 2009

Gier, J.T., and Dunkle, R.V., (1958), "Selective spectral characteristics as an important factor in the efficiency of solar collectors", *Transactions of the Conference on the Use of Solar Energy*, Vol. 2, University of Arizona Press, Tucson, pp.41, 1958

Griffiths, D.J., (1999), "Introduction to Electrodynamics", 3rd Edition, Prentice Hall, New Jersey 07458, USA

Garnett, J.C.M., (1904), "Colours in Metal Glassed and in Metallic Films", *Philos. Trans. R. Soc. London,* Vol. 203, pp. 385-420, 1904

Glaude, A.S., Bousquet, I., Thomas, L., Flamant, G., (2013), "Optical modeling of multilayered coatingsbased on SiC(N)H materials for their potential use as high-temperature solar selective absorbers", *Solar Energy Materials and Solar Cells,* Vol. 117, pp. 315-323, 2013

Galione, P.A., Baroni, A.L., Ramos-Barrado, J. R., Leinen, D., Martín, F., Marotti, R. E., & Dalchiele, E.A., (2010), "Origin of solar thermal selectivity and interference effects in nickel-alumina nanostructured films", *Surface and Coatings Technology*, Vol. 204, pp. 2197–2201, 2010

Gaouyat, L., Mirabella, F., & Deparis, O., (2013), "Critical tuning of magnetron sputtering process parameters for optimized solar selective absorption of $NiCrO_x$ cermet coatings on aluminium substrate", *Applied Surface Science*, Vol. 271, pp. 113–117, 2013

Granqvist, C.G., and Niklasson, G.A., (1977), "Selective absorption of solar energy in ultrafine chromium particles", *Applied Physics letters*, Vol. 31, pp. 665-666, 1977

Gelin, K., Boström, T., & Wäckelgård, E., (2004), "Thermal emittance of sputter deposited infrared reflectors in spectrally selective tandem solar absorbers", *Solar Energy*, Vol. 77, pp. 115–119, 2004

Gampp, R., Oelhafen, P., Gantenbein, P., Brunold, S., Frei, U., (1998), "Accelerated aging tests of chromium containing amorphous hydrogenated carbon coatings for solar collectors", *Solar Energy Materials and Solar Cells*, Vol. 54, pp. 369–377, 1998

Gong, D., Liu, H., Luo, G., Zhang, P., Cheng, X., Yang, B., Wang, Y., Min, J., Wang, W., Chen, S., Cui, Z., Li, K., Hu., L., (2015), "Thermal aging test of AlCrNO-based solar selective absorbing coatings prepared by cathodic arc plating", *Solar Energy Materials & Solar Cells*, Vol. 136, pp. 167–171, 2015

Grimmer, D.P., & Collier, R.K., (1981), "Black-chrome solar-selective coatings electrodeposited on metallized glass tubes", *Solar Energy*, Vol. 26, pp. 467–469, 1981

Gupta, V., Patra, M.K., Shukla, A., Saini, L., Songara, S., Jani, R., Vadera, S.R., Kumar, N., (2014), "Synthesis and Investigations on Microwave Absorption Properties of Core–Shell FeCo(C) Alloy Nanoparticles", *Science of Advanced Materials*, Vol. 6, pp. 1196–1202, 2014

Grips, V.K.W., Barshilia, H.C., Selvi, V.E., Rajam, K.S., (2006), "Electrochemical behavior of single layer CrN , TiN TiAlN coatings and nanolayered TiAlN/CrN multilayer coatings prepared by reactive direct current magnetron sputtering", Vol. 514, pp. 204–211, 2006

Holland, L., (1956), "Vacuum Deposition of thin films", Champan & Hall, London, UK, 1956

Harding, G.L., (1979), "Alternative grading profile for sputtered solar selective surface," *Journal of Vacuum Science and Technology,* Vol. 16, pp. 2111-2113, 1979

Hamid, Z.A., (2009), "Electrodeposition of black chromium from environmentally electrolyte based on trivalent chromium salt", *Surface and Coatings Technology*, Vol. 203, pp. 3442–3449, 2009

Hogg, S.W., & Smith, G.B., (1977), "The unusual and useful optical properties of electrodeposited chrome-black films", *Journal of Physics D: Applied Physics*, Vol. 10, pp. 1863–1869, 1977

Holloway, P.H., Shanker, K., Pettit, R.B., & Sowell, R.R., (1980), "Oxidation of electrodeposited black chrome selective solar absorber films", *Thin Solid Films*, Vol. 72, pp. 121–128, 1980

Han, J., Wan, F., Zhu, Z., Liao, Y., Ji, T., Ge, M., Zhang, Z., (2005), "Shift in low-frequency vibrational spectra of transition-metal zirconium compounds", *Appl. Phys. Lett.* Vol. 87, pp. 172107, 2005

Huang, J.H., Lin, T.C., Yu, G.P., (2011), "Phase transition and mechanical properties of ZrN_xO_y thin films on AISI 304 stainless Steel", *Surf. Coat. Technol.,* Vol. 206, pp. 107-116, 2011

Huang, J.H., Lin, T.C., Yu, G.P., (2011), "Structure evolution and mechanical properties of ZrN_xO_y thin film deposited on Si by magnetron sputtering", *Surf. Coat. Technol.* Vol. 205, pp. 5093-5102, 2011

Huang, J.H., Lin, T.C., Yu, G.P., (2009), "Heat treatment induced phase separation and phase transformation of ZrN_xO_y thin films deposited by ion plating", *Surf. Coat. Technol.*, Vol. 203, pp. 3491-3500, 2009

Huang, J.-H., Ouyang, F.-Y., Yu, G.-P., (2007), "Effect of film thickness and Ti interlayer on the structure and properties of nanocrystalline TiN thin films on AISI D2 steel", *Surf. Coatings Technol.*, Vol. 201, pp. 7043–7053, 2007

Huang, J.-H., Chang, K.-H., Yu, G.-P., (2007), "Synthesis and characterization of nanocrystalline ZrN_xO_y thin films on Si by ion plating", *Surf. Coatings Technol.* Vol. 201, pp. 6404–6413, 2007

Huang, J.-H., Tsai, Z.-E., Yu, G.-P., (2008), "Mechanical properties and corrosion resistance of nanocrystalline ZrN_xO_y coatings on AISI 304 stainless steel by ion plating", *Surf. Coatings Technol.*, Vol. 202, pp. 4992–5000, 2008

Hofmann, D.M., Hofstaetter, A., Leiter, F., Zhou, H., Henecker, F., Meyer, B. K., et al., (2002), "Hydrogen: a relevant shallow donor in zinc oxide", *Physical Review Letters*, Vol.88, pp. 045504, 2002

Hu, W.K., (2000), "Electrocatalytic properties of new electrocatalysts for hydrogen evolution in alkaline water electrolysis", *International Journal of Hydrogen Energy*, Vol. 25, pp. 111–8, 2000

Harinipriya, S., Usmani, B., Rogers, D.J., Sandana, V.E., Hosseini Teherani, F., Lusson, A., Bove, P., Drouhin, H.-J., Razeghi, M., (2012), "ZnO Nanorod Electrodes for Hydrogen Evolution & Storage", Proc. of SPIE Vol. 8263 82631Y-1, 2012

Harrington, D.A., Conway, B.E., (1987), "AC impedance of faradaic reactions involving electrosorbed intermediatesdI. Kinetic theory", *Electrochimica Acta,* Vol. 32, pp.1703, 1987

Harinipriya, S., Sangaranarayanan, M.V., (2002), "Influence of the Work Function on Electron Transfer Processes at Metals: Application to the Hydrogen Evolution Reaction", *Langmuir*, Vol. 18, pp. 5572, 2002

Iqbal, M., (1983), "An Introduction to Solar Radiation", Academic Press, Ontario, Canada, 1983

Ignatiev, A., O'Neill, P., Doland, C., & Zajac, G., (1979), "Microstructure dependence of the optical properties of solar-absorbing black chrome", *Applied Physics Letters*, Vol. 34, pp. 42, 1979

Ithurbide, A., Frateur, I., Galtayries, A., & Marcus, P., (2007), "XPS and flow-cell EQCM study of albumin adsorption on passivated chromium surfaces: Influence of potential and pH", *Electrochimica Acta*, Vol. 53, pp. 1336–1345, 2007

Inal, O.T., Valayapetre, M., Murr, L. E., & Torma, A. E., (1981), "Microstructural and mechanical property evaluation of black-chrome coated solar collectors — II", *Solar Energy Materials*, Vol. 4(3), pp. 333–358, 1981

Ignatiev, A., O'Neill, P., Doland, C., & Zajac, G., (1979a), "Microstructure dependence of the optical properties of solar-absorbing black chrome", *Applied Physics Letters*, Vol. 34, PP. 42, 1979

Joerger, R., Gamppa, R., Heinzel, A., Graf, W., Kohl, M., Gantenbein, P., Oelhafen, P., (1998), "Optical properties of inhomogeneous media", *Solar Energy Materials and Solar Cells,* Vol. 54, pp. 351-361, 1998

Ignatiev, A., O'Neill, P., & Zajac, G., (1979b), "The surface microstructure optical properties relationship in solar absorbers: black chrome", *Solar Energy Materials*, Vol. 1, pp. 69–79, 1979

Japelj, B., Vuk, A.Š., Orel, B., Perše, L.S., Jerman, I., & Kovač, J., (2008), "Preparation of a TiMEMO nanocomposite by the sol–gel method and its application in coloured thickness insensitive spectrally selective (TISS) coatings", *Solar Energy Materials and Solar Cells*, Vol. 92, pp.1149–1161, 2008

Joly, M., Antonetti, Y., Python, M., Gonzalez, M., Gascou, T., Scartezzini, J.-L., Schüler, A., (2013), "Novel black selective coating for tubular solar absorbers based on a sol–gel method", *Sol. Energy* Vol. 94, pp. 233–239, 2013

Jaworske, D.A., (2002) "Duraibility of Solar Selective Coatings Simulated Space Enviroment", NASA Glenn Research Center, Cleveland, OH 44135, 2002

Jafari, S, Rozati, S.M., (2011), "Characterization of black chrome film prepared by electroplating technique", *World Renewable Energy Congress- 2011, Sweden,* 2011

Joint Committee on Powder Diffraction Standards, File No. 01-074-7045

Joint Committee on Powder Diffraction Standards, File No. 00-065-6829

Joint Committee on Powder Diffraction Standards, File No. 01-077-7591

Joanna, P., Antoni, B., (2007), "Production and electrochemical characterization of Ni-based composite coatings containing titanium, vanadium or molybdenum powders", *Surface and Coatings Technology*, Vol. 201, pp. 6478–83, 2007

Kalogirou, S.A., (2004), "Solar thermal collectors and applications", *Progress in Energy and Combustion Science*, Vol. 30, pp. 231-295, 2004

Kennedy, C.E., (2002), "Review of Mid-to High-Temperature Solar Absorber Materials", *NREL/TP-520-31267, National Renewable Energy Laboratory,* Colorado, 2002

Kanu, S.S., Binions, R., (2010), "Thin film for solar control applications", *Proc R Soc A: Math Phys Eng Sci*, Vol. 466, pp. 19-44, 2010

Katumba, G., Olumekor, L., Forbes, A., Makiwa, G., Mwakikunga, B., Lu, J., Wackelgard, E., (2008), " Optical, thermal and structural characteristics of carbon nanoparticles embedded in ZnO and NiO as selective solar absorbers", *Solar Energy Materials and Solar Cells,* Vol. 92, pp. 1285-1292, 2008

Kennedy, C.E., (2014), "High Temperature Solar Selective coatings", *U.S. Patent N0. 8893711*, 25, 2014

Konttinen, P., Lund, P.D., Kilpi, R.J., (2003), "Mechanically manufactured selective solar absorber surfaces", *Solar Energy Materials and Solar Cells,* Vol. 79, pp. 273-283, 2003

Kennedy, C.E., (2010), "High temperature solar selective coatings," 2010

Kaluza, L., Orel, B., Drazic, G., Kohl, M., (2001), "Sol-gel derived $CuCoMnO_x$ spinel coatings for solar absorbers: Structural and optical properties", *Solar Energy Materials and Solar Cells,* Vol. 70, pp. 187-201, 2001

Karthick Kumar, S., Suresh, S., Murugesan, S., & Raj, S.P., (2013), "CuO thin films made of nanofibers for solar selective absorber applications", *Solar Energy*, Vo. 94, pp. 299–304, 2013

Koželj, M., Vuk, A.Š., Jerman, I., & Orel, B., (2009), "Corrosion protection of Sunselect, a spectrally selective solar absorber coating, by (3-mercaptopropyl)trimethoxysilane", *Solar Energy Materials and Solar Cells*, Vol. 93, pp. 1733–1742, 2009

Kunič, R., Mihelčič, M., Orel, B., Slemenik Perše, L., Bizjak, B., Kovač, J., & Brunold, S., (2011), "Life expectancy prediction and application properties of novel polyurethane based thickness sensitive and thickness insensitive spectrally selective paint coatings for solar absorbers", *Solar Energy Materials and Solar Cells*, Vol.95, pp. 2965–2975, 2011

Klochko, N.P., Klepikova, K.S., Tyukhov, I.I., Myagchenko, Y.O., Melnychuk, E.E., Kopach, V.R., Khrypunov, G.S., Lyubov, V.M., Kopach, A.V., Starikov, V.V., Kirichenko, M.V., (2015), "Zinc oxide-nickel cermet selective coatings obtained by sequential electrodeposition", *Solar Energy*, Vol. 117, pp. 1–9, 2015

Kaluza, L., OrelL, B., Drazic, G., & Kohl. M., (2001), "Sol – gel derived $CuCoMnO_x$ spinel coatings for solar absorbers : Structural and optical properties", *Solar Energy Materials & Solar Cell*, Vol. 70, pp. 187–201, 2001

Köhl, M., Heck, M., Brunold, S., Frei, U., Carlsson, B., & Möller, K., (2004), "Advanced procedure for the assessment of the lifetime of solar absorber coatings", *Solar Energy Materials and Solar Cells*, Vol. 84, pp. 275–289, 2004

Katzen, D., Levy, E., Mastai, Y., (2005), "Thin films of silica–carbon nanocomposites for selective solar absorbers", *Appl. Surf. Sci.* Vol. 248, pp. 514–517, 2005

Katumba, G., Makiwa, G., Baisitse, T.R., Olumekor, L., Forbes, A., & Wäckelgård, E., (2008a), "Solar selective absorber functionality of carbon nanoparticles embedded in SiO_2, ZnO and NiO matrices", *Physica Status Solidi (C)*, Vol. 5(2), pp. 549–551, 2008

Kotilainen, M., Mizohata, K., Honkanen, M., & Vuoristo, P., (2014), "Influence of microstructure on temperature-induced ageing mechanisms of different solar absorber coatings", *Solar Energy Materials and Solar Cells*, Vol. 120, pp. 462–472, 2014

Kalogirous, S.A., (2004), "Solar Thermal Collectors and applications", *Progress in Energy and combustion Science,* Vol. 30, pp. 231-295, 2004

Kelly, P.J., & Arnell, R.D., (2000), "Magnetron sputtering: a review of recent developments and applications", *Vacuum*, Vol. 56, pp. 159–172, 2000

Kirchhoff, V., and Kopte, T., (1996), "High-Power Pulsed Magnetron Sputtering Technology", *39th Annual Technical Conference Proceedings of the Society of Vacuum Coaters*, pp. 117-122, 1996

Kouznetsov, V., (2001), "Method and Apparatus for Megnetically Enhanced Sputtering", U.S. Patent 6, 296,742, 2001

Kisinger, P.T., Heineman, W.R., (1996), "Laboratory Techniques in Electroanalytical Chemistry", Second Edition, Marcel Dekker, Inc. New York, 1996

Kissinger, P.T., and Heineman, W.R., (1996), "Laboratory Technique in Electrochemistry", 2nd Edition, Marcel Dekker, Inc., NY Basel, 1996

Kurt, R., Sanjines, R., Karimi, A., Lévy, F., (2000), "Structural and mechanical properties of CN_x thin films prepared by magnetron sputtering", *Diam. Relat. Mater.* Vol. 9, pp. 566–572, 2000

Kittel, C., (1995), "Introduction to solid state physics", 7th Edition. John Wiley & Sons, INC., U.K., 1995

Kubelka, P., Munk, F., (1931), "Ein Beitrag zur Optik der. Farbanstriche", *Z. Tech. Phys.* (*Leipzig*), Vol. 12, pp. 593–601, 1931

Keramidas, V.G., White, W.B., (1974), "Raman scattering study of the crystallization and phase transformations of ZrO_2", *J. Am. Ceram. Soc.*, Vol. 57, pp. 22–24, 1947

Kubaschewski, O., (1993), "Materials thermochemistry", Pergamon Press, Oxford, 1993

Kılıc, C., and Zunger, A., (2002), "n-type doping of oxides by hydrogen", *Applied Physics Letters*, Vol. 81, pp. 73, 2002

Lior, N., (2008), "Energy resources and use: The present situation and possible paths to the future", *Energy*, Vol. 33, pp. 842-857, 2008

Liu, S.-Y., Perng, Y.-H., Ho, Y.-F., (2013), "The effect of renewable energy application on Taiwan buildings: What are the challenges and strategies for solar energy exploitation?", *Renewable and Sustainable Energy Reviews,* Vol. 28, pp. 92-106, 2013

Lampart, C.M., (1979), "Coatings for enhanced photothermal energy collection", *Solar Energy Materials*, Vol. 1, pp. 319-341, 1979

Lind, M.A., Pettit, R.B., and Masterson, K.D., (1980), "The Sensitivity of Solar Transmittance Reflectance and Absorptance to Selected Averaging Procedure and Solar Irradiance Distributions", *Trans. ASME*, Vol.102, pp. 34-40, 1980

Lei, H., ShuMao, W., Lijun, J., XiaoPeng, L., HuaLing, L., ZhiNian, L., (2009), "Preparation and thermal stability on non-vacuum high temperature solar selective absorbing coatings", *Chinese Science Bulletin*, Vol. 54, pp. 1451-1454, 2009

Lira-Cantú, M., Sabio, A.M., Brustenga, A., and Gómez-Romero, P., (2005), "Electrochemical deposition of black nickel solar absorber coatings on stainless steel AISI316L for thermal solar cells", *Solar Energy Materials and Solar Cells*, Vol. 87, pp. 685–694, 2005

Lampart, C.M., (1978), "Microstructure of a Black Chrome Solar Selective Absorber", *SPIE 22nd Institutional Technical Symposium,* San Diego, CA, Agust 28-31, 1978

Lampart, C.M., (1979), "Microstructure and Optical Properties of Black Chrome before and after exposure to high Temperatures", Second Annual 1 Conference on absorber Surfaces for Solar Recievers, Boulder, Colorado, January 24-25, 1979

Lampart, C.M., (1980c), "Metallurgical analysis and high temperature degration of the black chrome solar selective absorber", *Thin Soid Film*, 1980

Lee, K.D., (2007), "Preparation and Characterization of Black Chrome Solar Selective Coatings", *Journal of the Korean Physical Society*, Vol. 51, pp. 135, 2007

Lee, K.D., Jung, W.C., & Kim, J.H., (2000), "Thermal degradation of black chrome coatings", *Solar Energy Materials and Solar Cells*, Vol.63, pp. 125–137, 2000

Li, L., (2000), "AC Anodization of Aluminum, Electrodeposition of Nickel and Optical Property Examination", *Solar Energy Materials and Solar Cells*, Vol. 64, pp. 279–289, 2000

Liu, Y., Wang, C., & Xue, Y., (2012), "The spectral properties and thermal stability of NbTiON solar selective absorbing coating", *Solar Energy Materials and Solar Cells*, Vol. 96, pp. 131–136, 2012

Lee, K.D., (2006), "Characterization of Cr-O Cermet Solar Selective Coatings Deposited by Using Direct-Current Magnetron Sputtering Technology", *Journal of the Korean Physical Society*, Vol. 49, pp. 187–194, 2006

Liu, Y., Wang, Z., Lei, D., & Wang, C., (2014), "A new solar spectral selective absorbing coating of SS–(Fe_3O_4)/Mo/TiZrN/TiZrON/SiON for high temperature application", *Solar Energy Materials and Solar Cells*, Vol. 127, pp. 143–146, 2014

Liu, Y., Wang, C., & Xue, Y., (2012), "The spectral properties and thermal stability of NbTiON solar selective absorbing coating", *Solar Energy Materials and Solar Cells*, Vol. 96, pp. 131–136, 2012

Liu, H.D., Wan, Q., Lin, B.Z., Wang, L.L., Yang, X.F., Wang, R.Y., Gong, D.Q., Wang, Y.B., Ren, F., Chen, Y.M., Cheng, X.D., Yang, B., (2014), "The spectral properties and thermal stability of CrAlO-based solar selective absorbing nanocomposite coating", *Solar Energy Materials and Solar Cells*, Vol. 122, pp. 226–232, 2014

Liu, H.D., Wan, Q., Xu, Y.R., Luo, C., Chen, Y.M., Fu, D.J., Ren, F., Luo, G., Cheng, X.D., Hu, X.J., Yang, B., (2015), "Long-term thermal stability of CrAlO-based solar selective absorbing coating in elevated temperature air", *Solar Energy Materials and Solar Cells*, Vol. 134, pp. 261–267, 2015

Larsson, J., (2007), "Electromagnetics from a quasistatic perspective", *American Journal of Physics*, Vol. 75, pp. 230, 2007

Lanxner, M., and Elgat, Z., (1990), "Solar select coating for high service temperature produced by plasma sputtering", *Proceeding of the Society of Photo-Optical Instrumentation Engineers,* Vol. 1272, pp. 240-249, 1990

Lou, H.H., Huang, Y., (2006), "Electroplating", *Encyclopedia of chemical processing* DOI: 10.1081/E-ECHIP-120007747, 2006

Leng, Y., (2013), "Materials Characterization: Introduction to microscopic and Spectroscopic Methods, 2nd Edtion, Wiley-CVH Vewrlag GmbH & Co. KGaA, 2013

Leach, R.K., 2001, "Measurement Good Practice Guide: The Measurement of Surface Texture using Stylus Instruments", *National Physical Laboratory*, 2001

Lampert, C.M., & Washburn, J. (1979), "Microstructure of a black chrome solar selective absorber", *Solar Energy Materials*, Vol. 1, pp. 81–92, 1979

Lee, S.J., Cho, J.-H., Lee, C., Cho, J., Kim, Y.-R., & Park, J.K., (2011), "Synthesis of highly magnetic graphite-encapsulated FeCo nanoparticles using a hydrothermal process", *Nanotechnology*, Vol. 22, pp. 375603, 2011

Lazarov, M.P., Mayer, I.V., (1997), U.S. Patent No.5,670,248, 1997

Lazarov, M.P., Mayer, I.V., (1998), U.S. Patent No. 5,776,556, 1997

Liu, C., Leyland, A., Bi, Q., Matthews, A., (2001), "Corrosion resistance of multi-layered plasma-assisted physical vapour deposition TiN and CrN coatings", *Surf. Coatings Technol.* Vol. 141, pp. 164–173, 2001

Lee, C.W., Eom, S.W., Sathiyanarayanan, K., and Yun, M.S., (2006), "Preliminary comparative studies of zinc and zinc oxide electrodes on corrosion reaction and reversible reaction for zinc/air fuel cells", *Electrochimica Acta*, Vol. 52, pp. 1588–1591, 2006

Lide, D.R., (1987), CRC Handbook of Chemistry and Physics, 68th Edition, CRC press Inc., Florida, USA, 1987

Mekhilef, S., Saidur, R., Safari, A., (2011), "A review on solar energy use in industries", *Renewable and Sustainable Energy Reviews,* Vol. 15, pp.1777-1790, 2011
Masters, G.M., (2004), "Renewable and Efficient Electric Power System", John Wiley & Sons, Inc., Hobken, New Jersey, USA, 2004
Mattox, D.M., (1997), "Handbook of Physical Vapor Deposition (PVD) Processing", Noyes Publications, Westwood, New Jersey, USA, 1997
Mckenzie, D.R., (1979), "Gold, silver, chromium and copper cermet selective surfaces for evacuated solar collectors", *Applied Physics Letters*, Vol. 34, pp. 25-28, 1979
Meinel, A.B., and Meinel, M.P., (1977), "Applied Solar Energy", Addison-Wesley, 1977
McDonald, G.E., and Curtis, H.B., (1976), Techn. Rept. No. NASA-TMX-73498, 1976
McKenzie, D.R., & Zybert, J.J., (1981), "Optimization of solar selectivity in colloidally produced solar selective coatings", *Thin Solid Films*, Vol. 85, pp.191–195, 1981
McDonald, G.E., (1974), "Refinemnet in black chrome for use as a solar selective coating", Lewies Research center, National Aeronautics and Space Administration, Washington, D.C., 1974
McDonald, G.E., and Curtis, H.B., (1975), "Variation of solar-selective properties of black chrome with plating time", Lewies Research center, NASA-TM-X-717331, 1975
Möller, T., & Hönicke, D., (1998), "Solar selective properties of electrodeposited thin layers on aluminium", *Solar Energy Materials and Solar Cells*, Vol. 54, pp. 397–403, 1998
Möller, T., & Hönicke, D., (1998), "Solar selective properties of electrodeposited thin layers on aluminium", *Solar Energy Materials and Solar Cells*, Vol. 54, pp. 397–403, 1998
McKenzie, D.R., (1979), "Gold, silver, chromium, and copper cermet selective surfaces for evacuated solar collectors", *Applied Physics Letters*, Vol. 34, pp. 25–28, 1979
McDonald, G., (1980), "A Preliminary Study of Solar Selective Coating System Using a Black Cobalt Oxide for High Temperature Solar Collectors", *Thin Solid Films,* Vol. 72, pp. 83-87, 1980
Moon, J., Kim, T.K., VanSaders, B., Choi, C., Liu, Z., Jin, S., & Chen, R., (2015), "Black oxide nanoparticles as durable solar absorbing material for high-temperature concentrating solar power system", *Solar Energy Materials and Solar Cells*, Vol. 134, pp. 417–424, 2015
Moon, J., Lu, D., VanSaders, B., Kim, T.K., Kong, S.D., Jin, S., Chen, R., Liu, Z., (2014), "High performance multi-scaled nanostructured spectrally selective coating for concentrating solar power", *Nano Energy*, Vol. 8, PP. 238–246, 2014
McClanahan, E.D., and Laegried, N., (1991), "Sputtering by Particle Bombardment III", Springer Verlag, Berlin, p. 339, 1991
Musil, J., Baroch, P., Vlček, J., Nam, K.H., & Han, J.G., (2005), "Reactive magnetron sputtering of thin films: present status and trends", *Thin Solid Films*, Vol. 475, pp. 208–218, 2005
Mattox, D.M., (1998),"Handbook of Physical Vapor Deposition (PVD) Processing: Flim Formation, Adhesion, Surface Preparation and Contamination control", Noyes Publications, Westwood, New Jersey, USA, 1998
Meyerhofer, D., (1978), "Characteristics of resist films produced by spinning", *Journal of Applied Physics*, Vol. 49(7), pp. 3993–3997, 1998
Mabon, J.C., Inal, O.T., & Singh, A.J., (1982), "An investigation of deposition parameter dependence of optical properties, microstructure and thermal stability of black chrome selective surfaces", *Solar Energy Materials*, Vol. 7, pp. 359–376, 1982
Mukhopadhyay, I., Aravinda, C.L., Borissov, D., & Freyland, W. (2005), "Electrodeposition of Ti from $TiCl_4$ in the ionic liquid l-methyl-3-butyl-imidazolium bis (trifluoro methyl sulfone) imide at room temperature: study on phase formation by in situ electrochemical scanning tunneling microscopy", *Electrochimica Acta*, Vol. 50, PP. 1275–1281, 2005
McDonald, G.E., (1975), "Spectral reflectance properties of black chrome for use as a solar selective coating", *Solar Energy*, Vol. 17, pp. 119–122, 1975
Murr, L.E., Inal, O.T., & Valayapetre, M., (1980), "Characterization of selective solar absorber microstructures: Electron microscope studies", *Thin Solid Films*, Vol. 72, pp. 111–120, 1980
Metikos-Hukovic, M., Grubac, Z., Radic, N., Tonejc, A., (2006), "Sputter deposited nanocrystalline Ni and Ni–W films as catalysts for hydrogen evolution", *Journal of Molecular Catalysis A: Chemical*, Vol., 249 pp. 172–80, 2006
Marcus, Y, (1991), "Thermodynamics of solvation of ions. Part 5.—Gibbs free energy of hydration at 298.15 K", *J. Chem. Soc. Faraday Trans.,* Vol. 87, pp. 2995-2999, 1991
Niklasson, G.A., Granqvist, C.G., (1984), "Optical properties and solar selectivity of co-evaporated Co-Al_2O_3 composite films", *Journal of Applied Physics*, Vol. 55, pp. 3382, 1984
Nikalasson, G.A., Granqvist, C.G., and Hunderi, O., (1981), "Effective Medium Models for the Optical Properties of Inhomogeneous Materials", *Appl. Opt.* Vol. 20, pp. 26-30, 1981

Niklasson, G.A., Granqvist, C.G., (1983), "Solar absorptance and thermal emittance of co-evaporated Co-Al_2O_3 cermet films", *Solar Energy Materials*, Vol. 7, pp. 501-510, 1983

Nyberg, G.A., & Buhrman, R.A., (1982), "Macroscopic surface roughness in metal-dielectric composite films : Photothermal absorber applications", Vol. 40, pp. 129–131, 1982

Niklasson, G.A., and Granqvist C.G., (1982), "Dielectric function of coevaporated Co-Al_2O_3 cermet films", *Applied Physics Letters*, Vol. 41, pp. 773, 1982

Nuru, Z.Y., Msimanga, M., Muller, T.F.G., Arendse, C.J., Mtshali, C., & Maaza, M., (2015), "Microstructural, optical properties and thermal stability of MgO/Zr/MgO multilayered selective solar absorber coatings", *Solar Energy*, Vol. 111, pp. 357–363, 2015

Niklasson, G.A., (1988), Co-Al_2O_3 selective solar absorbing films: structure and effective medium theory for the optical properties", *Solar Energy Materials*, Vol. 17, pp. 217–226, 1988

Nunes, C., Teixeira, V., Collares-Pereira, M., Monteiro, A., Roman, E., & Martin-Gago, J., (2002), "Deposition of PVD solar absorber coatings for high-efficiency thermal collectors", *Vacuum*, Vol. 67, pp. 623–627, 2002

Nuru, Z.Y., Arendse, C.J., Nemutudi, R., Nemraoui, O., & Maaza, M., (2012), "Pt–Al_2O_3 nanocoatings for high temperature concentrated solar thermal power applications", *Physica B: Condensed Matter*, Vol. 407, pp. 1634–1637, 2012

Nuru, Z.Y., Arendse, C.J., Muller, T.F., Khamlich, S., & Maaza, M., (2014), "Thermal stability of electron beam evaporated Al_xO_y/Pt/Al_xO_y multilayer solar absorber coatings", *Solar Energy Materials and Solar Cells*, Vol. 120, pp. 473–480, 2014

Nuru, Z.Y., Arendse, C.J., Muller, T.F.G., & Maaza, M., (2012), "Structural and optical properties of Al_xO_y/Pt/Al_xO_y multilayer absorber", *Materials Science and Engineering: B*, Vol. 177, pp. 1194–1199, 2012

Nou, J., Chauvin, R., Thil, S., and Grieu, S., (2016), "A new approach to the real-time assessment of the clear-sky direct normal irradiance", *Applied Mathematical Modelling*, Vol. 40, pp. 7245–7264, 2016

Orel, Z.C., Gunde, M.K., (2001), "Spectrally selective paint coatings: Preparation and characterization", *Solar Energy Materials and Solar Cells,* Vol. 68, pp. 337-353, 2001

Orel, B., Crnjak Orel, Z., Jerman, R., Radoczy, I., (1990), "Coil-coating paints for solar collector panels—II. FT-IR spectroscopic investigations", Sol. Wind Technol. Vol. 7, pp. 713–717, 1990

Orel, B., Crnjak Orel, Z., Krainer, A., & Hutchins, M. G., (1991), "FTIR spectroscopic investigations and t the thermal stability of thickness sensitive spectrally selective (TSSS) paint coatings", *Solar Energy Materials*, Vol.22, pp. 259–279, 1991

Orel, Z.C., & Klanjs, M., (2001), "Spectrally selective paint coatings: Preparation and characterization", *Solar Energy Materials & Solar Cell*, Vol. 68, pp. 337–353, 2001

Orel, B., Spreizer, H., Slemenik Perše, L., Fir, M., Šurca Vuk, a., Merlini, D., Vodlan, M., Köhl, M., (2007), "Silicone-based thickness insensitive spectrally selective (TISS) paints as selective paint coatings for coloured solar absorbers (Part I), *Solar Energy Materials and Solar Cells*, Vol. 91, pp. 93–107, 2007

Orel, B., Spreizer, H., Slemenik Perše, L., Fir, M., Šurca Vuk, a., Merlini, D., Vodlan, M., Köhl, M., (2007), "Silicone-based thickness insensitive spectrally selective (TISS) paints as selective paint coatings for coloured solar absorbers (Part II), *Solar Energy Materials and Solar Cells*, Vol. 91, pp. 108–119, 2007

Oliver, W.C., Pharr, G.M., (1992), "An improved technique for determining hardness and elastic modulus using load and displacement sensing indentation experiments", *J. Mater. Res.* Vol. 7, pp. 1564–1583, 1992

Oliver, W.C., & Pharr, G.M., (2004), "Measurement of hardness and elastic modulus by instrumented indentation Advances in understanding and refinements to methodology", *Materials Research Society*, Vol. 19, pp. 3–20, 2004

Overberg, M.E., Heo, Y.W., Norton, D.P., Pearton, S.J., Stutz, C.E., et al., (2003), "Hydrogen incorporation, diffusivity and evolution in bulk ZnO", *Solid-State Electronics*, Vol. 47, pp. 2255–2259, 2003

Ozgur, U., Alivov, Y.I., Liu, C., Teke, A., Reshchikov, M.A., Dogan, S., Avrutin, V., Cho, S.-J., Morkoc, H.J., (2005), "A comprehensive review of ZnO materials and devices", *Appl. Phys.,* Vol. 98, pp. 0413011–30, 2005

Palik, E.D., (1998), "Handbook of optical constant of solids III", *Academic Press,* 1998

Patel, S.N., Intal, O.T., Singh, A.J., and Schrer, A., (1985), "Optimization and thermal degradation study of black nickel solar collector coatings", *Solar Energy Materials*, Vol. 11, pp. 381-399, 1985

Pettit, R.B., & Brinker, C.J., (1986), "Use of sol-gel thin films in solar energy applications", *Solar Energy Materials*, Vol 14, pp. 269–287, 1986

Peterson, R.E., and Ramsey, J.W., (1975), "Thin film coatings in solar−thermal power systems", *Journal of Vacuum Science and Technology*, Vol. 12, pp. 174, 1975

Pettit, R.B., and Sowell, R.R., (1976), "Solar absorptance and emittance properties of several solar coatings", *Journal of Vacuum Science and Technology*, Vol. 13, pp. 596, 1976

Prasad, A.A., Taylor, R.A., and Kay, M., (2015), "Assessment of direct normal irradiance and cloud connections using satellite data over Australia", *Applied Energy*, Vol. 143, pp. 301–311, 2015

Pettit, R.B., (1976), "Solar absorptance and emittance properties of several solar coatings", *Journal of Vacuum Science and Technology*, Vol. 13, pp. 596, 1976

Paunovic, M., and Schlesinger, M., (2006), "Fundamental of Electrochemical Deposition", 2nd Edition, John Wiley & Sons, Inc., Hobken, New Jersey, USA, 2006

Richtmyer, F.K. and Kennard, E.H., (1947), "Introduction to Modern Physics", 4th Edition, McGraw-Hill, New York, USA, 1947

Pradhan, A.A., and Shah, S.I., (2002), " High Deposition Rate Ractive Sputtering with Hollow Cathode," *45th Annual Technical Conference Proceeding of the Society of Vacuum Coaters*, pp. 96-100, 2002

Paunovic, M., and Schlesinger, M., (2006), "Fundamentals of Electrochemical Deposition", 2nd Eddition, John Willey & Sons, Inc., Publication, 2006

Perissi, I., Bardi, U., Caporali, S., & Lavacchi, A., (2006), "High temperature corrosion properties of ionic liquids", *Corrosion Science*, Vol. 48, pp. 2349–2362, 2006

Prasad, G.S.S, Mohan, S., Vasu, K.I., (1980), "Microstructural Characterization of an Electrodeposited Black Chromium Surface", *J. Electrochem. Soc. India,* Vol. 29, pp.82, 1980

Poddar, P., Wilson, J. L., Srikanth, H., Ravi, B.G., Wachsmuth, J., & Sudarshan, T.S., (2004), "Grain size influence on soft ferromagnetic properties in Fe-Co nanoparticles", *Materials Science and Engineering B: Solid-State Materials for Advanced Technology*, Vol. 106, pp. 95–100, 2004

Petch, N.J., (1953), "The cleavage strength of polycrystals", *Tetsu To Hagane*, Vol. 174, pp. 25–28, 1953

Pau, J.L., Piqueras, J., Rogers, D.J., Hosseini Teherani, F., Minder, K., McClintock, R., Razeghi, M., (2010), "On the interface properties of ZnO/Si electroluminescent diodes", *J. Appl. Phys.* Vol. 107, pp. 033719, 2010

Quintana, J., Sebastian, P. J., (1994), "The influence of various substrate treatments on morphology and selective absorber characteristics of electrochemical black chrome", *Sol. Energy Mater. Sol. Cells*, Vol. 33, pp. 465–474, 1994

Quinten, M., (2011), "Optical Properties of Nanoparticle Systems", Mie and Beyo, Wiley-VCH Publisher, 2011

Qing, H., Huiren, L., Jianshe, C., Xujun, W., (2003), "A study of the electrodeposited Ni–S alloys as hydrogen evolution reaction cathodes", *International Journal of Hydrogen Energy*, Vol. 28, pp. 1207–12, 2003

Qing, H., Huiren, L., Jianshe, C., Xin, L., Xujun, W., (2004), "Study of amorphous Ni–S–Co alloy used as hydrogen evolution reaction cathode in alkaline medium", *International Journal of Hydrogen Energy*, Vol. 29, pp. 243–8, 2004

Rredc, (2015), http://rredc.nrel.gov/solar/spectra/am1.5/, 2015

Rincón, M.E., Molina, J. D., Sánchez, M., Arancibia, C., & García, E., (2007), "Optical characterization of tandem absorber/reflector systems based on titanium oxide–carbon coatings", *Solar Energy Materials and Solar Cells*, Vol.91, pp.1421–1425, 2007

Roro, K.T., Tile, N., & Forbes, A., (2012), "Preparation and characterization of carbon/nickel oxide nanocomposite coatings for solar absorber applications", *Applied Surface Science*, Vol. 258, pp. 7174–7180, 2012

Roro, K.T., Tile, N., Mwakikunga, B., Yalisi, B., & Forbes, A., (2012), "Solar absorption and thermal emission properties of multiwall carbon nanotube/nickel oxide nanocomposite thin films synthesized by sol–gel process", *Materials Science and Engineering: B*, Vol. 177, pp. 581–587, 2012

Rebouta, L., Pitães, A., Andritschky, M., Capela, P., Cerqueira, M.F., Matilainen, A., & Pischow, K., (2012), "Optical characterization of TiAlN/TiAlON/SiO_2 absorber for solar selective applications", *Surface and Coatings Technology*, Vol. 211, pp. 41–44., 2012

Rebouta, L., Sousa, A., Capela, P., Andritschky, M., Santilli, P., Matilainen, A., Pischow, K., Barradas, N.P., Alves, E., (2015), "Solar selective absorbers based on Al_2O_3:W cermets and AlSiN/AlSiON layers", *Solar Energy Materials and Solar Cells*, Vol. 137, pp. 93–100, 2015

Rossnagel, S.M., (1991), "In Thin Film Processes II, Vossen, J.L., and Kern, W., eds., Academic Press, New York, 1991

Rajan, T.V., Sharma, C.P., Sharma, A., (1992), "Heat Treatment: Principles and technique", Prentence Hall, 1992

Rajagopalan, I., Gripps, W., Vasudevan, N., Rajagopalan, S.R., Ramaseshan, S., (1978), "A New Process for Black Coatings Useful in Harnessing Solar Energy I - A Room Temperature Black Chromium Plating Bath", *Proceedings of the International Solar Energy Society Conference, New Delhi, India, January 16-21,* Vol. 2, p. 855, 1978

Reiss, H., (1981), "Polymer layers protective against corrosion and abrasion, transparent in the infrared and with low thermal emissivity on electrodeposited selectively absorbing surfaces in solar collectors", *Thin Solid Films*, Vol. 75, pp. 261–269, 1981

Ritchie, I.T., Sharma, S.K., Valignat, J., & Spitz, J., (1979), "Thermal degradation of chromium black solar selective absorbers", *Solar Energy Materials*, Vol. 2, pp. 167–176, 1979

Riedl, H., Koller, C.M., Munnik, F., Hutter, H., Martin, F.M., Rachbauer, R., et al., (2016), "Influence of oxygen impurities on growth morphology, structure and mechanical properties of Ti-Al-N thin films", *Thin Solid Films,* Vol. 603, pp. 39–49, 2016

Roberge, P.R., (2008), "Corrosion engineering: principles and practice", McGrow Hil, 2008

Rosalbino, F., Maccio, D., Angelini, E., Saccone, A., Delfino, S., (2005), "Electrocatalytic properties of Fe–R (R = rare earth metal) crystalline alloys as hydrogen electrodes in alkaline water electrolysis", *Journal of Alloys and Compounds,* Vol.403, pp. 275–82, 2008

Rossmeisl, J., Qu, Z.W., Zhu, H., Kroes, G.J., Nørskov, J.K., (2007), "Electrolysis of water on oxide surfaces", *Journal of Electroanalytical Chemistry*, Vol. 607, pp. 83–89, 2007

Rogers, D.J., Sandana, V.E., Hosseini Teherani, F., McClintock, R., Razeghi, M., and Drouhin, H.J., (2011), "Amorphous ZnO Films Grown by Room Temperature Pulsed Laser Deposition on Paper and Mylar for Transparent Electronics Applications", *Proc. of SPIE*, Vol. 7940, pp. 79401K-1, 2011

Rogers, D.J., Sandana, V.E., Hosseini Teherani, F., McClintock, R., Razeghi, M., and Drouhin, H.J., (2009), "Fabrication of Nanostructured Heterojunction LEDs Using Self-Forming "Moth-Eye" Type Arrays of n-ZnO Nanocones Grown on p-Si (111) Substrates by Pulsed Laser Deposition", *Proc. of SPIE,* Vol. 7217, pp. 721708-1, 2009

Rau Greg, H., (2004), "Possible use of Fe/CO_2 fuel cells for CO_2 mitigation plus H_2 and electricity production", *Energy Conversion and Management,* Vol. 45, pp.2143–52, 2004

Solanki, C.S., (2013), "Solar Photovoltaics Fundamentals, Technologies and Applications", 2nd Edition, PHI Learning Private Limited, Delhi, India, 2013

Schnitzer, H., Christoph, B., Gwehenberger, G., (2007), "Minimizing greenhouse gas emission through the application of solar thermal energy in industrial processes. Approaching zero emissions", *Journal of Cleaner Production*, Vol. 15, pp. 1271-86, 2007

Selvakumar, N., Barshilia, H.C., (2012), "Review of physical vapor deposition (PVD) spectrally selective coatings for mid- and high-temperature solar thermal applications", *Solar Energy Materials and Solar Cells,* Vol. 98, pp. 1-23, 2012

Seraphin, B.O., (1979), "Solar Energy Conversion: Solid-State Physics Aspects: Topics in applied Physics", Springer Berlin, Germany, 1979

Selvakumar, N., Barshilia, H.C., (2012), "Review of physical vapor deposition (PVD) spectrally selective coatings for mid- and high-temperature solar thermal applications", *Solar Energy Materials and Solar Cells,* Vol. 98, pp. 1-23, 2012

Sukhatme, S.P., and Nayak, J.K., (2008), "Solar Energy Principle of thermal collection and Storage", 3rd Edition, Tata McGraw Hill Education Private Limited, New Delhi, India

Shashikala, A.R., Sharma, A.K., & Bhandari, D.R., (2007), "Solar selective black nickel–cobalt coatings on aluminum alloys", *Solar Energy Materials Solar Cells*, Vol. 91, pp. 629–635, 2007

Sebastian, P.J., Quintana, J., & Avila, F., (1997), "Retention of the high optical absorptance in thermally aged black chrome on variably sensitized Cu", *Solar Energy Materials and Solar Cells*, Vol. 45, pp. 65–74, 1997

Suzer, S., Kadirgan, F., Sohmen, H.M., Wetherilt, A.J., & Ture, I.E., (1998), "Spectroscopic characterization of Al_2O_3-Ni selective absorbers for solar collectors", *Solar Energy Materials and Solar Cells*, Vol. 52, pp. 55–60, 1998

Salmi, J., Bonino, J.P., & Bes, R.S., (2000), "Nickel pigmented anodized aluminum as solar selective absorbers", *Journal of Materials Science*, Vol. 35, pp. 1347–1351, 2000

Signore, M.A., Sytchkova,A., &Rizzo, A., (2011), "Sputtering deposition and characterization of tandem absorbers for photo-thermal systems operating at mid temperature", *Optical Materials*, Vol.34, pp. 292–297, 2011

Selvakumar, N., Santhoshkumar, S., Basu, S., Biswas, a., & Barshilia, H.C., (2013), "Spectrally selective CrMoN/CrON tandem absorber for mid-temperature solar thermal applications", *Solar Energy Materials and Solar Cells*, Vol. 109, pp. 97–103, 2013

Schön, J.H., Binder, G., & Bucher, E., (1994), "Performance and stability of some new high-temperature selective absorber systems based on metal/dielectric multilayers", *Solar Energy Materials and Solar Cells*, Vol. 33, pp. 403–416, 1994

Selvakumar, N., Barshilia, H.C., Rajam, K.S.S., & Biswas, A., (2010), "Structure, optical properties and thermal stability of pulsed sputter deposited high temperature $HfO_x/Mo/HfO_2$ solar selective absorbers", *Solar Energy Materials and Solar Cells,* Vol. 94, PP. 1412–1420, 2010

Shumway, A., Jaworske, A., & Jaworske, D.A., (2003), "Solar Selective Coatings for High Temperature Applications", *AIP Conference Proceedings*, Vol. 654, pp. 65–70, 2003

Selvakumar, N., Manikandanath, N.T., Biswas, A., & Barshilia, H.C., (2012), "Design and fabrication of highly thermally stable $HfMoN/HfON/Al_2O_3$ tandem absorber for solar thermal power generation applications", *Solar Energy Materials and Solar Cells*, Vol. 102, pp. 86–92, 2012

Shah, A.A., Ungaro, C., & Gupta, M.C., (2015), "High temperature spectral selective coatings for solar thermal systems by laser sintering", *Solar Energy Materials and Solar Cells*, Vol. 134, pp. 209–214, 2015

Sai, H., Yugami, H., Kanamori, Y., & Hane, K., (2003), "Solar selective absorbers based on two-dimensional W surface gratings with submicron periods for high-temperature photothermal conversion", *Solar Energy Materials and Solar Cells*, Vol. 79, pp. 35–49, 2003

Soum-Glaude, A., Bousquet, I., Thomas, L., & Flamant, G., (2013), "Optical modeling of multilayered coatings based on SiC(N)H materials for their potential use as high-temperature solar selective absorbers", *Solar Energy Materials and Solar Cells*, Vol. 117, pp. 315–323, 2013

Soum-Glaude, A., Bousquet, I., Bichotte, M., Quoizola, S., Thomas, L., & Flamant, G., (2014), "Optical Characterization and Modeling of Coatings Intended as High Temperature Solar Selective Absorbers", *Energy Procedia*, Vol. 49, pp. 530–537, 2014

Selvakumar, N., & Barshilia, H.C., (2012), "Review of physical vapor deposited (PVD) spectrally selective coatings for mid- and high-temperature solar thermal applications", *Solar Energy Materials and Solar Cells*, Vol. 98, pp. 1–23, 2012

Shah, S.I., (1995), "Handbook of Thin Film Process Technology," IOP Publishing Ltd, 1995

Siegfried, D.E., Cook, D., and Glocker, D., (1996), "Reactive Cylindrical Magnetron Deposition of Titanium Nitride and Zirconium Nitride Films", *39th Annual Technical Conference Proceeding of the Society of Vaccum Coater*, pp. 97-101, 1996

Schiller, S., Goedicke, K., Reschke, J., Kirchhoff, V., Schneider, S., & Milde, F., (1993), "Pulsed magnetron sputter technology", *Surface and Coatings Technology*, Vol. 61, pp. 331–337, 1993

Schiller, S., Goedicke, K., Kirchhoff, V., and Kopte, T., (1995), "Pulsed Technology- a New Era of Magnetron sputtering", *38th Annual Technical Conference Proceeding of the Society of Vacuum Coaters*, pp. 293-297, 1995

Stern, M., and Geary, A.L., (1957), "Electrochemical Polarization", *J. Electrochem. Soc.*, Vol. 104, pp. 559, 1957

Skoog, D.A., West, D.M., Holler, F.J., Crouch, S.R., (2004), "Fundamnetal of Analytical Chemistry", Eitght Edition, Cengage Learning India Private Limited, 2004

Schlesinger, M., and Paunovic, M., (2000), "Modern Electroplating", John Wiley & Sons, Inc., New York, 2000

Sweet, J.N., Pettit, R.B., & Chamberlain, M.B., (1984), "Optical modeling and aging characteristics of thermally stable black chrome solar selective coatings", *Solar Energy Materials*, Vol. 10, PP. 251–286, 1984

Song, Y., & Chin, D.-T., (2002), "Current efficiency and polarization behavior of trivalent chromium electrodeposition process", *Electrochimica Acta*, Vol. 48, pp. 349–356, 2002

Surviliene, S., Orlovskaja, L., & Biallozor, S. (1999), "Black chromium electrodeposition on electrodes modified with formic acid and the corrosion resistance of the coating", *Surface and Coatings Technology*, Vol. 122, pp. 235–241, 1999

Spitz, J., Van Danh, T., & Aubert, A. (1979), "Chromium black coatings for photothermal conversion of solar energy, part I: Preparation and structural characterization", *Solar Energy Materials*, Vol. 1, pp. 189–200, 1979

Seo, W. S., Lee, J. H., Sun, X., Suzuki, Y., Mann, D., Liu, Z., Terashima, M., Yang, P.C., McConnell, M.V., Nishimura, D.G., Dai, H., (2006), "FeCo/graphitic-shell nanocrystals as advanced magnetic-resonance-imaging and near-infrared agents", *Nature Materials*, Vol. 5, pp. 971–976, 2006

Selvakumar, N., Barshilia, H.C., Rajam, K.S., Biswas, A., (2010), "Structure, optical properties and thermal stability of pulsed sputter deposited high temperature $HfO_x/Mo/HfO_2$ solar selective absorbers", *Sol. Energy Mater. Sol. Cells,* Vol.94, pp. 1412–1420, 2010

Siu, G.G., Stokes, M.J., Liu, Y., (1999), "Variation of fundamental and higher-order Raman spectra of ZrO_2 nanograins with annealing temperature", *Phys. Rev. B,* Vol. 59, pp. 3173–3179, 1999

Shackelford, J.F., Alexander, W., (2001), "Materials Science and Engineering Handbook", 3rd Edition CRC Press LLC, 2001

Selvakumar, N., Barshilia, H.C., Rajam, K.S., Biswas, A., (2010), "Structure, optical properties and thermal stability of pulsed sputter deposited high temperature HfO_x/Mo/HfO_2 solar selective absorbers", *Sol. Energy Mater. Sol. Cells,* Vol. 94, pp.1412–1420, 2010

Sharma, A., Varshney, M., Shin, H.-J., Kumar, Y., Gautam, S., Chae, K.H., (2014), "Monoclinic to tetragonal phase transition in ZrO_2 thin films under swift heavy ion irradiation: Structural and electronic structure study", *Chem. Phys. Lett.,* Vol. 592, pp. 85–89, 2014

Stern, M., Geary, A.L., (1957), "Electrochemical Polarization", *J. Electrochem. Soc.,* Vol. 104, pp. 559, 1957

Shinn, M., Hultman, L., Barnett, S.A., (1992), "Growth, structure, and microhardness of epitaxial TiN/NbN superlattices", *J. Mater. Res.*, Vol. 7, pp. 901–911, 1992

Sylwestrowicz, W., Hall, E.O., (1951), "The deformation and ageing of mild steel", *Proc. Phys. Soc. London*, *Sect. B,* Vol. 64, pp. 495, 1951

Satsangia Vibha, R., Saroj, K., Singha Aadesh, P., Rohit, S., Sahab, D., (2008), "Nanostructured hematite for photoelectrochemical generation of hydrogen", *International Journal of Hydrogen Energy*, Vol. 33, pp. 312–8, 2008

Shan, Z., Liu, Y., Chen, Z., Warrender, G., Tian, J., (2008), "Amorphous Ni–S–Mn alloy as hydrogen evolution reaction cathode in alkaline medium", *International Journal of Hydrogen Energy,* Vol. 33, pp. 28–33, 2008

Sandana, V.E., Rogers, D.J., Teherani, F.H., McClintock, R., Bayram, C., Razeghi, M., Drouhin, H.-J., Clochard, M.C., Sallet, V., Garry, G., Falyouni, F., (2009), "Comparison of ZnO Nanostructures Grown Using Pulsed Laser Deposition, Metal Organic Chemical Vapour Deposition & Physical Vapour Transport", *J. Vac. Sci. Technol.*,Vol. B 27, pp. 1678, 2009

Sandana, V.E., Rogers, D.J., Hosseini Teherani, F., Orsal, G., Molinari, M., Troyon, M., Gautier, S., Moudakir, T., Abid, M., Ougazzaden, A., Largeteau, A., Demazeau, G., Drouhin, H.-J., Scott, C., Razeghi, M., (2011), "Growth of "moth-eye" ZnO nanostructures on Si (111), c-Al_2O_3, ZnO and steel substrates by PLD & their use as templates for MOVPE growth of GaN submitted to Journal of Crystal Growth, 2011

Thirugnanasambandam, M., Iniyan, S., Goic, R., (2010), "A review of solar thermal technologies", *Renewable and Sustainable Energy Reviews,* Vol. 14, pp. 312-322, 2010

Tabor, H., (1956), "Selective radiation: I. Wavelength discrimination, II. Wavefront discrimination", *Bulletin of the Research Council of Israel*, 5A, pp. 119-134, 1956

Tabor, H., (1961), "Solar collectors, selective surfaces and heat engines", *Proceedings of the National Academy of Science of the United States of America*, Vol. 47, pp. 1271-1278, 1961

Tesfamichael, T., (2000), "Characterization of Selective Solar Absorber, Department of Materials Science", *The Angstrom Laboratory*, Uppsala University, 2000

Tang, W.T., Ying, Z.F., Hu, Z.G., Li, W.W., Sun, J., Xu, N., Wu, J.D., (2010), "Synthesis and characterization of HfO_2 and ZrO_2 thin films deposited by plasma assisted reactive pulsed laser deposition at low temperature, *Thin Solid Films*, Vol. 518, pp. 5442-5446, 2010

Tabor, H. (1961), " Solar collectors, selective surfaces and heat engines", *Proceedings of the National Academy of Science of the United States of America*, Vol. 47, pp. 1271-1278, 1961

Tesfamichael, T., Hoel, A., Wäckelgård, E., Niklasson, G.A., Gunde, M.K., & Orel, Z.C., (2001), "Optical characterization and modeling of black pigments used in thickness-sensitive solar-selective absorbing paints", *Solar Energy*, Vol. 69, pp. 35–43, 2001

Tharamani, C.N., & Mayanna, S.M., (2007), "Low-cost black Cu-Ni alloy coatings for solar selective applications", *Solar Energy Materials and Solar Cells*, Vol. 91, pp. 664–669, 2007

Tesfamichael, T., Vargas, W.E., Wackelgard, E., & Niklasson, G.A., (1997), "Optical properties of silicon pigmented alumina films", *Journal of Applied Physics*, Vol. 82, pp. 3508–3513, 1997

Tesfamichael, T., Vargas, W.E., Wackelgard, E., & Niklasson, G.A., (1998), "A feasibility study of integrally colored Al-Si as a solar selective absorber", *Solar Energy Materials and Solar Cells*, Vol. 55, pp. 251–265, 1998

Tulchinsky, D., Uvarov, V., Popov, I., Mandler, D., & Magdassi, S., (2014), "A novel non-selective coating material for solar thermal potential application formed by reaction between sol–gel titania and copper manganese spinel", *Solar Energy Materials and Solar Cells*, Vol. 120, pp. 23–29, 2014

Teixeira, V., Sousa, E., Costa, M.F., Nunes, C., Rosa, L., Carvalho, M.J., Collares-Pereira, M., Roman, E., Gago, J., (2001), "Spectrally selective composite coatings of Cr-Cr_2O_3 and Mo-Al_2O_3 for solar energy applications," *Thin Solid Films,* Vol. 392, pp. 320–326, 2001

Turgut, Z., Scott, J. H., Huang, M. Q., Majetich, S. A., & McHenry, M. E., (1998), "Magnetic properties and ordering in C-coated Fe_xCo_{1-x} alloy nanocrystals", *Journal of Applied Physics*, Vol. 83, pp. 6468, 1998

Tam, K.H., Cheung, C.K., Leung, Y.H., Djurisic, A.B., Ling, C.C., Beling, C.D., et al., (2006), "Defects in ZnO nanorods prepared by a hydrothermal method", *The Journal of Physical Chemistry B*, Vol. 110, pp. 20865–20871, 2006

Trasatti, S., (1976), "In *Advances in Electrochemistry and Electrochemical Engineering*, Gerisher, H., Tobias, C.W., Eds.; John Wiley and Sons: New York, Vol. 10, p. 298, 1976

Trasatti, S., (1972), "Work function, electronegativity, and electrochemical behavior of metals: III. Electrolytic hydrogen evolution in acid solutions", *J. Electroanal. Chem.,* Vol. 39, pp. 163-184, 1972

Usmani, B., Harinipriya, S., (2013), "Characterization black chrome films in presence and absence of graphite encapsultaed FeCo nanoparticles by electrodepoaition technique for solar thermal applications, *ECS Transactions*, Vol. 53, pp. 47-61, 2013

Usmani, B., Vijay, V., Chhibber, R., Chandra, L., Dixit, A., (2016a), "Zirconium carbide-nitride composite matrix based solar absorber structures on glass and aluminum substrates for solar thermal applications", ISES Proceeding (In press), 2016

Usmani, B., Dixit, A., (2016b), "Spectrally selective response of ZrO_x/ZrC-ZrN/Zr absorber-reflector tandem structures on stainless steel and copper substrates for high temperature solar thermal applications", *Solar Energy*, Vol. 134, pp. 353-365, 2016

Usmani, B., Vijay, V., Chhibber, R., Dixit, A., (2016c), "Optimization of sputtered zirconium films infrared reflector in spectrally selective solar absorbers", *Journal of Thin Solid Films*, (In revision), 2016

Usmani, B., Vijay, V., Chhibber, R., Dixit, A., (2016d), "Investigation of ZrO_x/ZrC-ZrN/Zr thin film structural evolution and their degradation using X-ray diffraction and Raman spectroscopy", *Appl. Phys. A,* Vol. 122, pp. 992, 2016

Usmani, B., Dixit, A., (2016e), "Impact of corrosion on microstructure and mechanical properties of ZrO_x/ZrC-ZrN/Zr absorber – reflector tandem solar selective structures", *Sol. Energy Mater. Sol. Cells*, Vol. 157, pp. 733-741, 2016

Usmani, B., Vijay, V., Chhibber, R., Dixit, A., (2016f), "solar performance analysis of ZrO_x/ZrC- ZrN/Zr absorber-reflector tandem structures under extreme thermal environment", Springer proceeding, (under review), 2016

Valleti, K., Murali Krishna, D., & Joshi, S.V., (2014), "Functional multi-layer nitride coatings for high temperature solar selective applications", *Solar Energy Materials and Solar Cells*, Vol. 121, pp. 14–21, 2014

Valayapetre, M., Inal, O.T., Murr, L.E., Torma, A.E., & Rosenthal, A., (1979), "Microstructural and mechanical property evaluation of black-chrome coated solar collectors", *Solar Energy Materials*, Vol. 2, pp. 177–199, 1979

Velumani, S., Mathew, X., Sebastian, P.J., Narayandass, Sa.K., Mangalaraj, D., (2003), "Structural and optical properties of hot wall deposited CdSe thin films", *Sol. Energy Mater. Sol. Cells.* Vol. 76 pp. 347–358, 2003

Vaz, F., Cerqueira, P., Rebouta, L., Nascimento, S.M., Alves, E., Goudeau, P., et al., (2004), "Structural, optical and mechanical properties of coloured TiN_xO_y thin films", *Thin Solid Films,* Vol. 447-448, pp. 449–454, 2004

Veprek, S., Veprek-Heijman, M., (2012), "Limits to the preparation of superhard nanocomposites: impurities, deposition and annealing temperature, *EMRS 2011 symp, Q, Thin Solid Films*, Vol. 522, pp. 274–282, 2012

Veziroglu, T.N., Barbir, F., (1995), "Transportation fuel-hydrogen In Energy technology and the environment", Vol. 4. pp. 2712–30, 1995

Van De Walle, C.G., (2001), "Defect analysis and engineering in ZnO", *Physica B*, Vol. 308-310, pp. 899–903, 2001

Van de Walle, C.G., (2002), "Strategies for Controlling the Conductivity of Wide-Band-Gap Semiconductors", *Physica Status Solidi (b)*, Vol. 229, pp. 221–228, 2002

Van De Walle, C.G., (2000), "Hydrogen as a cause of doping in zinc oxide", *Physical Review Letters*, Vol. 85, pp. 1012–5, 2000

Vinogradov, S.N., Linnel, R.H., (1971) "Hydrogen Bonding", Chaps. 2, 3, 4, and 6, "Van Nostrand Reinhold, New York, 1971

Vien, T.K., Sella, C., Lafait, J., & Berthier, S., (1985), "Pt-Al_2O_3 selective cermet coatings on superalloy

substrates for photothermal conversion up to 600°C", *Thin Solid Films*, Vol. 126, pp. 17–22, 1985

Wackelgard, E., (1998), "Characterization of black nickel solar absorber coatings electroplated in a nickel chlorine aqueous solution", SEM, Vol. 56, pp. 35, 1998

Wu, Y., Zheng, W., Lin, L., Qu, Y., & Lai, F., (2013), "Colored solar selective absorbing coatings with metal Ti and dielectric AlN multilayer structure", *Solar Energy Materials and Solar Cells*, Vol. 115, pp. 145–150, 2013

Wu, L., Gao, J., Liu, Z., Liang, L., Xia, F., & Cao, H., (2013), "Thermal aging characteristics of CrN_xO_y solar selective absorber coating for flat plate solar thermal collector applications", *Solar Energy Materials and Solar Cells*, Vol. 114, pp. 186–191, 2013

Wäckelgård, E., Mattsson, A., Bartali, R., Gerosa, R., Gottardi, G., Gustavsson, F., Laidani, N., Micheli, V., Primetzhofer, D., Rivolta, B., (2015), "Development of W–SiO_2 and Nb–TiO_2 solar absorber coatings for combined heat and power systems at intermediate operation temperatures", *Solar Energy Materials and Solar Cells*, Vol. 133, pp. 180–193, 2015

Wang, H., Prasad Sivan, V., Mitchell, A., Rosengarten, G., Phelan, P., & Wang, L., (2015), "Highly efficient selective metamaterial absorber for high-temperature solar thermal energy harvesting", *Solar Energy Materials and Solar Cells*, Vol. 137, pp. 235–242, 2015

Window, B., Savvides, N., (1986), "Charged particle fluxes from planar magnetron sputtering sources", *Journal of Vacuum Science & Technology A: Vacuum, Surfaces, and Films*, Vol. 4, pp. 196, 1986

Waite, M.M., Shah, S.I., Glocker, D.A., (2010), " Sputtering Sources", *SVC Bulletin Spring*, pp. 42–50, 2010

Waits, R.K., (1978), "Planar magnetron sputtering", *Journal of Vacuum Science and Technology*, Vol. 15, pp. 179-187, 1978

Wang, J., (2006), "Analytical Electrochemistry", Third Eddition, John Wiley & Sons, Inc. Hoboken, New Jersey, 2006

Wiesendanger, R., (1994), " Scanning Probe Microscopy and Spectroscopy: methods and applications", Cambridge University Press, 1994

Window, B., Ritchie, I.T., & Cathro, K., (1979), "A study of selective electroplated chrome blacks", *Thin Solid Films*, Vol. 57, pp. 309–314, 1979

Williamson, G.B., Smallman, R.C., (1956), *Phil. Mag*. Vol. 1, pp. 34, 1956

Wang, Y., Lu, Z.W., Gao, X.P., Hu, W.K., Jiang, X.Y., Qu, J.Q., et al, (2005), "Electrochemical properties of the ball-milled $LaMg_{10}Ni_{2-x}Al_x$ alloys with Ni powders (x = 0, 0.5, 1 and 1.5)", *Journal of Alloys and Compounds*, Vol. 389, pp. 290–5, 2005

Wolcott, A., Smith, W.A., Kuykendall, T.R., Zhao, Y., and Zhang, J. Z., "Photoelectrochemical Study of Nanostructured ZnO Thin Films for Hydrogen Generation from Water Splitting", *Adv. Funct. Mater.,* Vol. 19, pp. 1849–1856

Wu, J.-J., and Liu, S.-C., (2002), "Catalyst-Free Growth and Characterization of ZnO Nanorods", *The Journal of Physical Chemistry B*, Vol. 106, pp. 9546–9551, 2002

Xiao, X., Miao, L., Xu, G., Lu, L., Su, Z., Wang, N., & Tanemura, S., (2011), "A facile process to prepare copper oxide thin films as solar selective absorbers", *Applied Surface Science*, Vol. 257, pp. 10729–10736, 2011

Xiao, X., Xu, G., Xiong, B., Chen, D., & Miao, L., (2012), "The film thickness dependent thermal stability of Al_2O_3:Ag thin films as high-temperature solar selective absorbers", *Journal of Nanoparticle Research*, Vol. 14, pp. 746, 2012

Xue, Y., Wang, C., Sun, Y., Wu, Y., Ning, Y., & Wang, W., (2014), "Effects of the LMVF and HMVF absorption layer thickness and metal volume fraction on optical properties of the $MoSi_2$–Al_2O_3 solar selective absorbing coating", *Vacuum*, Vol. 104, pp. 116–121, 2014

Xu, M.H., Zhong, W., Wang, Z.H., Au, C., & Du, Y.W., (2013), "Highly stable FeCo/carbon composites : Magnetic properties and microwave response", Vol. 52, pp. 14–20, 2013

Xinkang, D., Cong, W., Tianmin, W., Long, Z., Buliang, C., Ning, R., (2008), "Microstructure and spectral selectivity of Mo–Al_2O_3 solar selective absorbing coatings after annealing", *Thin Solid Films,* Vol. 516, pp. 3971–3977, 2008

Yin, Y., McKenzie, D.R., McFall, W.D., (1996), "Cathodic arc deposition of solar thermal selective surfaces", *Solar Energy Materials and Solar Cells*, Vol. 44, pp. 69-78, 1996

Yue, S., Yueyan, S., & Fengchun, W., (2003), "High-temperature optical properties and stability of Al_xO_y-AlN_x-Al solar selective absorbing surface prepared by DC magnetron reactive sputtering", *Solar Energy Materials and Solar Cells*, Vol. 77, pp. 393–403, 2003

Yoo, Y.H., Le, D.P., Kim, J.G., Kim, S.K., Van Vinh, P., (2008), "Corrosion behavior of TiN, TiAlN, TiAlSiN

thin films deposited on tool steel in the 3.5 wt.% NaCl solution", *Thin Solid Films,* Vol. 516 pp. 3544–3548, 2008

Yan, Y., Ahn, K.S., Shet, S., Deutsch, T., Huda, M., Wei, S.H., Turner, J., Al-Jassim, M.M., (2007), "Band gap reduction of ZnO for photoelectrochemical splitting of water", *Proc. of SPIE,* Vol. 6650, pp. 66500H-1

Zhao, S., Wackelgard, E., (2006), "The optical properties of sputtered composite of Al-AlN", *Solar Energy Materials and Solar Cells,* Vol. 90, pp. 1861-1874, 2006

Zhang, Q.C., (1999), "High efficiency Al-N cermet solar coatings with double layer film structures", *Journal of Physics D-Applied Physics*, Vol. 32, pp. 1938-1944, 1999

Zajac, G., Smith, G.B., & Ignatiev, A., (1980), "Refinement of solar absorbing black chrome microstructure and its relationship to optical degradation mechanisms", *Journal of Applied Physics*, Vol. 51, pp. 5544-5554, 1980

Zhang, Q.-C., & Mills, D.R., (1992a), "High solar performance selective surface using bi-sublayer cermet film structures", *Solar Energy Materials and Solar Cells*, Vol. 27, pp. 273–290, 1992a

Zhang, Q.-C., Zhao, K., Zhang, B.-C., Wang, L.-F., Shen, Z.-L., Lu, D.-Q., Xie, D.-L., Zhou, Z.-J., Li, B.-F., (1998), "A cylindrical magnetron sputtering system for deposition metal-aluminum nitride cermet solar coatings onto batches of tubes", *J. Vac. Sci. Technol. A*, Vol. 16, pp. 628-632, 1998

Zhao, S., Avendaño, E., Gelin, K., Lu, J., Wäckelgård, E., (2006), "Optimization of an industrial DC magnetron sputtering process for graded composition solar thermal absorbing layer", *Solar Energy Materials and Solar Cells*, Vol. 90, pp. 308–328, 2006

Zhou, W.-X., Shen, Y., Hu, E.-T., Zhao, Y., Sheng, M.-Y., Zheng, Y.-X., S.-Y. Wang, Y.-P., Lee, C.-Z., Wang, D. W., Lynch, and Chen, L.-Y., (2012), "Nano-Cr-film-based solar selective absorber with high photo-thermal conversion efficiency and good thermal stability", *Optics Express*, Vol. 20, pp. 28953–62, 2012

Zhang, Q.-C., & Mills, D.R., (1992b), "New cermet film structures with much improved selectivity for solar thermal applications", *Applied Physics Letters*, Vol. 60, pp. 545, 1992b

Zhang, Q.-C., & Mills, D.R., (1992c), "New cermet film structures with much improved selectivity for solar thermal applications", *Applied Physics Letters*, Vol. 60, pp. 545, 1992c

Zhang, Q., Yin, Y., & Mills, D.R., (1996), "High efficiency Mo-Al_20_3 cermet selective surfaces for high-temperature application", *Solar Energy Materials and Solar Cells*, Vol. 40, pp. 43–53, 1996

Zhang, Q., Hadavi, M.S., Lee, K., & Shen, Y.G., (2003), "Zr–ZrO_2 cermet solar coatings designed by modelling calculations and deposited by dc magnetron sputtering", *Journal of Physics D: Applied Physics*, Vol.36, pp. 723-729, 2003

Zheng, L., Gao, F., Zhao, S., Zhou, F., Nshimiyimana, J.P., & Diao, X., (2013), "Optical design and co-sputtering preparation of high performance Mo–SiO_2 cermet solar selective absorbing coating", *Applied Surface Science*, Vol. 280, pp. 240–246, 2013

Zheng, L., Zhou, F., Zhou, Z., Song, X., Dong, G., Wang, M., & Diao, X., (2015), "Angular solar absorptance and thermal stability of Mo–SiO_2 double cermet solar selective absorber coating", *Solar Energy*, Vol. 115, pp. 341–346, 2015

Zhang, Q., (1998), "Stainless-steel–AlN cermet selective surfaces deposited by direct current magnetron sputtering technology", *Solar Energy Materials and Solar Cells*, Vol. 52, pp. 95–106, 1998

Zhang, Q.C., Zhao, K., Zhang, B. C., Wang, L. F., Shen, Z. L., Zhou, Z. J., Lu, D.-Q., Xie, D.-L., Li, B. F., (1998), "New cermet solar coatings for solar thermal electricity applications" *Solar Energy*, Vol. 64, pp. 109–114, 1998

Zhang, Q.-C., & Shen, Y., (2004), "High performance W–AlN cermet solar coatings designed by modelling calculations and deposited by DC magnetron sputtering", *Solar Energy Materials and Solar Cells*, Vol. 81, pp. 25–37

Zhang, Q.C., Kelly, J.C., & Mills, D.R., (1991), "Possible high absorptance and low emittance selective surface for high temperature solar thermal collectors", *Applied Optics*, Vol. 30, pp. 1653–8, 1991

Zhang, Q., (2000), "Recent progress in high-temperature solar selective coatings", *Solar Energy Materials and Solar Cells*, Vol. 62, pp. 63–74, 2000

Zhang, S., Li, L., and Kumar, A., (2009), "Materials Characterization Techniques", CRC Press, Taylor & Francis Group, Boca Raton London, New York, 2009

Zein El Abedin, S., Borissenko, N., & Endres, F., (2004), "Electrodeposition of nanoscale silicon in a room temperature ionic liquid", *Electrochemistry Communications*, Vol. 6, pp. 510-514, 2004

Zajac, G., Smith, G.B., & Ignatiev, A., (1980), "Refinement of solar absorbing black chrome microstructure and its relationship to optical degradation mechanisms", *Journal of Applied Physics*, Vol. 51, pp. 5544, 1980

Zajac, G., & Ignatiev, A., (1979), "High temperature optical and structural degradation of black chrome

coatings", *Solar Energy Materials*, Vol. 2, pp. 239–247, 1979

Zhang, Q.-C., Hadavi, M.S., Lee, K.-D., Shen, Y.G., (2003), "Zr-ZrO_2 cermet solar coatings designed by modelling calculations and deposited by dc magnetron sputtering. *Journal of Physics D: Applied Physics*, Vol. 36, pp. 723–729, 2003

Zhao, Z.W., Lei, W., Zhang, X.B., Wang, B.P., Tay, B.K., (2009), "Nanocrystalline zirconium oxide thin films grown under low pulsed dc voltages", *J. Phys. D. Appl. Phys.,* Vol. 42, pp. 215408, 2009

Zaban, A., Aruna, S.T., Tirosh, S., Gregg, B.A., Mastai, Y., (2000), "The effect of the preparation condition of TiO_2 colloids on their surface structures", *The Journal of Physical Chemistry B*, Vol. 104, pp. 4130, 2000

…