Abstract

The joining of glass with metal plays an important role in various applications including vacuum tube, Solid Oxide fuel cell, electronics component, parabolic trough receiver tube (PTRT).The presented research is focused on the development of novel glass-metal joint for PTRTs.

The initial aim of present investigation was to select a suitable glass-metal joint combination on the basis of wettability, surface roughness, pre-oxidation time, microstructural and X-ray diffraction studies. Later, an unmatched glass-metal joint between borosilicate glass and austenitic stainless steel SS 304 was developed after selecting the suitable glass-metal joint combination. $40SiO_2$-$54B_2O_3$-$4Na_2O$-$2Al_2O_3$ material was used as the glass sealant to join the SS304 metal ring and borosilicate glass tube. The chemical compositions of glass sealant were investigated by changing SiO_2/B_2O_3 ratio by using statistical design of experiment approach for SiO_2-Al_2O_3-B_2O_3-Na_2O system. The effect of SiO_2/B_2O_3 ratio in glass sealant on wettability, glass transition temperature Tg and crystallization temperature Tc, thermal conductivity, adhesion and density were studied.

The fabricated joint was subjected to different environmental condition and the degradation of the joint was studied over the period of time. The residual stresses generated in the joint after a thermal cycling for 50 cycles were measured with the help of photo-elastic technique. The joint is subjected to different thermal cycling temperatures i.e. 150 °C, 200 °C and 250 °C and also subjected to open environment and water for approximately 200 hours. The thermal cycling result revealed that the glass-metal joint specimen in water degraded much faster as compared to the specimen expose to atmosphere.

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