3
Problem Formulation

3.1 GAPS IN THE STUDY

Review of literatures suggested that a number of studies have been carried out on parabolic rough receiver tube used by using Kovar alloy and Kodial glass combination having matched type geometry as shown in Figure 3.1. The reported coefficient of thermal expansion for Kovar alloy and Kodial glass is given as 5.0×10^{-6}m/m°C and 3.3×10^{-6}m/m°C respectively. The metal ring was fitted between the glass tubes, in the presence of heat using glass blowing technique. The joining glass with other metal is therefore an important issue because of the mismatch in their coefficient of thermal expansion. The thermal coefficient mismatch issue can be solved by changing design geometry of glass-metal joint. Many researchers have suggested the use of compression joint geometry to solve thermal expansion mismatch issue.

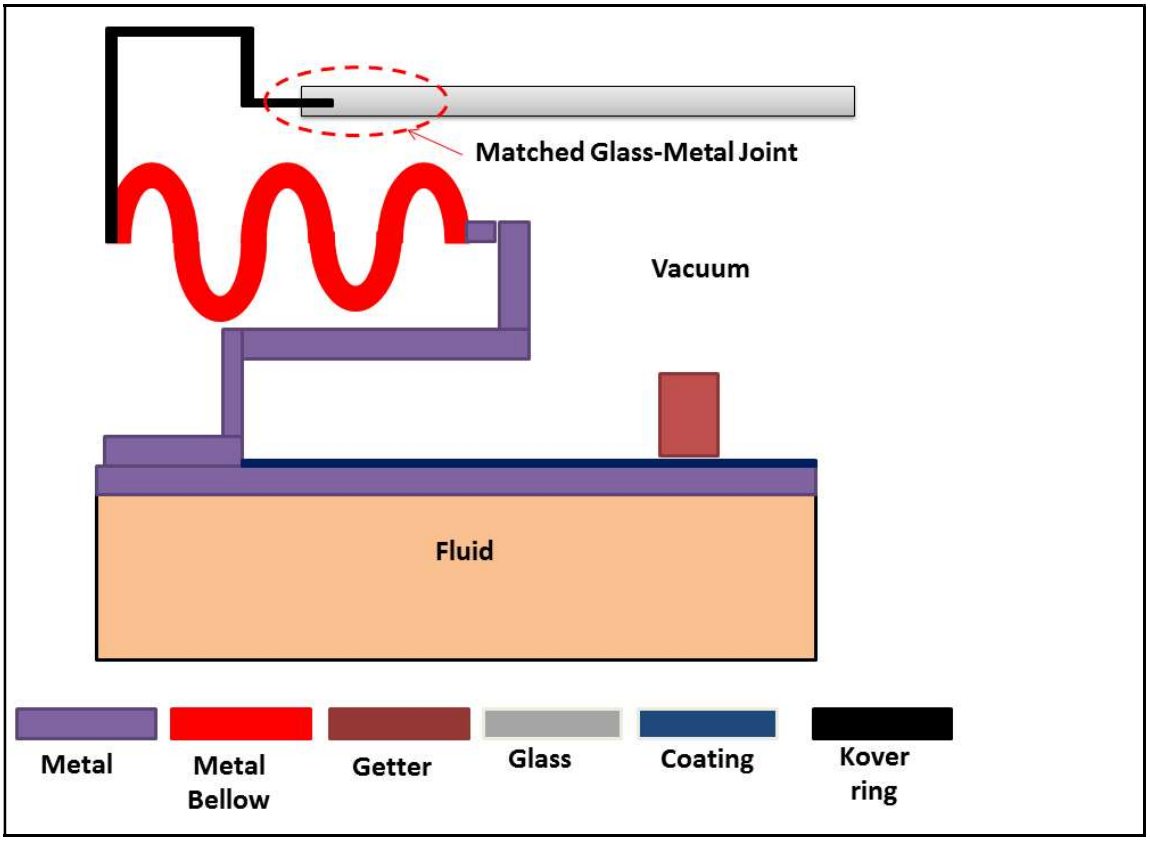


Figure 3.1: Existing Glass-metal Joint Geometry (Matched Joint geometry)

The literature also suggested that the joining of glass with metal depends mainly upon, glass-metal combination (based on their coefficient of thermal expansion), (pre-oxidation time and temperature), surface roughness, microstructural changes, and oxide scale formation, selection of joint design, optimum metal thickness in order to achieve successful joint and residual stress generation reported by [Lei et al.(2010); Shekoofa et al., 2014; Tian,Y et al., 2015].

3.2 PROBLEM FORMULATION AND OBJECTIVE OF THE STUDY

Based on the research gap identified from the literature, this research is focused on the design and development of glass-metal joint using compression joint geometry.

The joint geometry of compression glass-metal joint for parabolic trough receiver tube is as shown in Figure 3.2

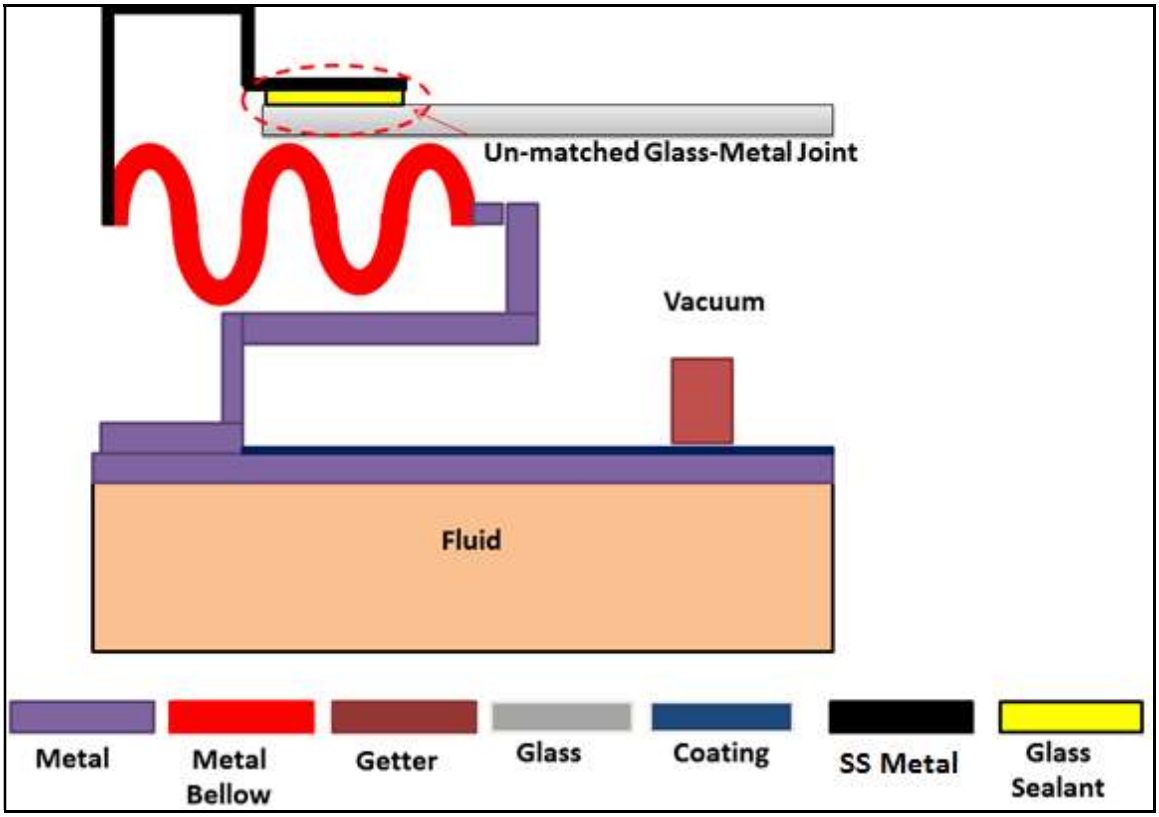


Figure 3.2: Proposed glass-metal joint geometry (Unmatched joint geometry)

The following are the identified obtained through research gap. The objectives identified are

- Selection of suitable glass-metal joint combination for investigation.
- Selection of the appropriate joint geometry on the basis of experimental trials and carrying out an interfacial characterization of the joint.
- Development of glass sealant having glass transition temperature less than that of the glass tube (by varying SiO_2/B_2O_3 ratio) and using mixture design technique to investigate its properties.
- Fabrication of the glass-metal joint and investigation of the role of metal thickness on the generation of residual stresses.
- Structural integrity assessment of fabricated glass-metal joint and the environmental degradation study of the glass-metal joint.

3.3 METHODOLOGY ADOPTED

The flow chart of methodology adopted for present research work is as shown in Figure 3.3.

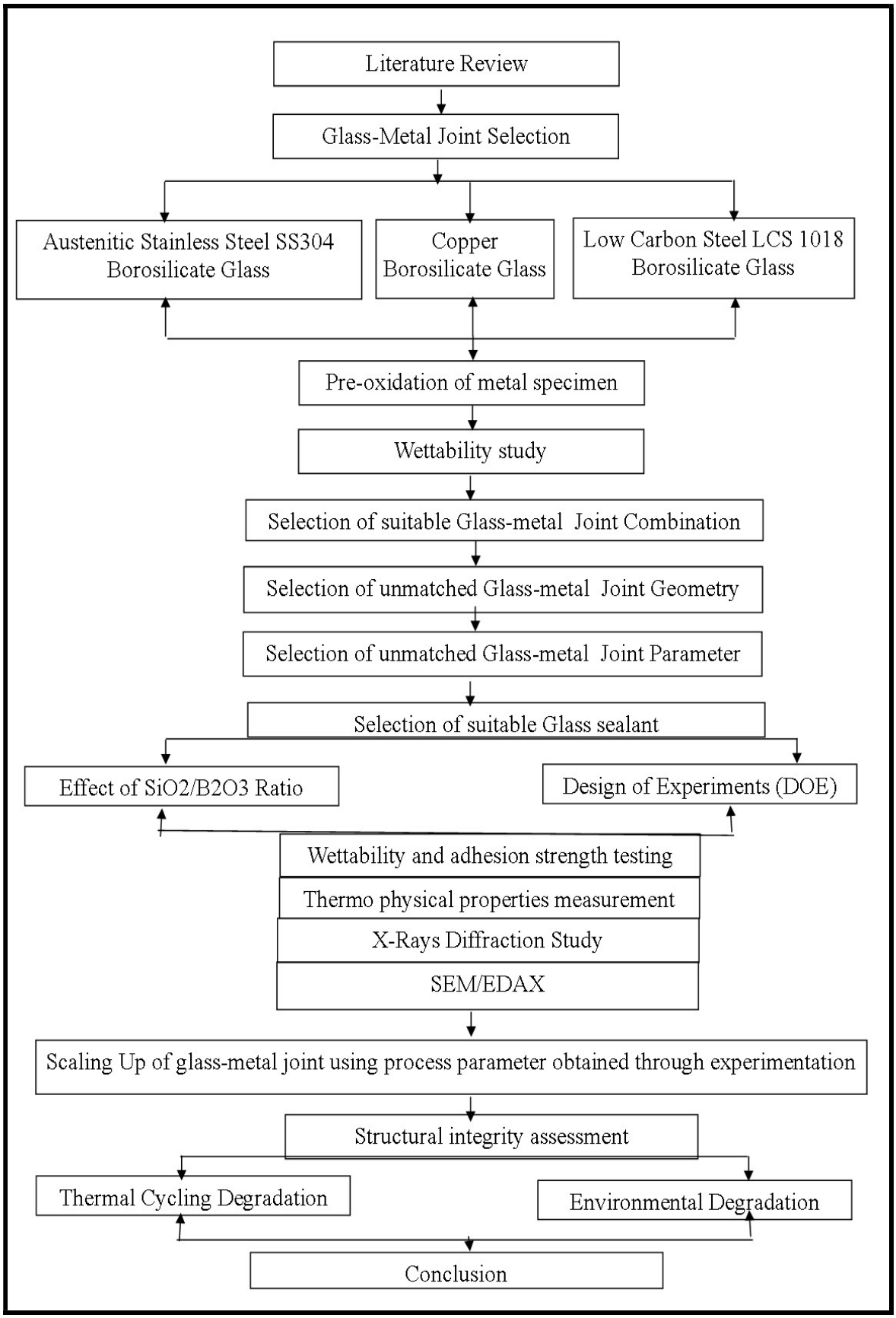


Figure 3.3: Methodology adopted

3.4 Summary

The chapter highlights the gaps identified during literature review. The formulated objectives of the research work to be carried out have also been identified. The methodology adopted for the research work has also been presented in detail.