Physico-chemistry of chromia in silicate melts

Carine Petitjean*[1], Pierre-Jean Panteix[1], Victor Szczepan[1], Christophe Rapin[1], and Michel Vilasi[1]

[1]Institut Jean Lamour (IJL) – CNRS, Institut Jean Lamour (CNRS – Université de Lorraine) – BP 70239 54506 Vandoeuvre les Nancy, France

Abstract

Glass industry requires metallic devices in contact with molten silicates. When platinum and ceramic cannot be used, chromia-forming superalloys are generally used. The passivation of the alloy is ensured by the growth of a chromia Cr2O3 layer by oxidation of the alloy. The passive state depends on the stability of the protective layer of Cr2O3 in molten silicates. The limitation of the dissolution of Cr2O3 into the glass solvent leads to a lower corrosion rate of the alloy. Thermodynamic data of chromium in melts (e.g. the solubility limit, the speciation, the diffusion in melts) are necessary to estimate the lifetime of the protective layer. The chemical equilibria are modified by the temperature, the basicity, the oxygen fugacity and the viscosity. To evaluate the influence of these parameters, simplified compositions have been chosen in the following systems: Na2O-SiO2, Na2O-CaO-SiO2 and Na2O-B2O3-SiO2. Equilibration of Cr2O3-rich melts has been reached through the use of a specific device allowing the independent control of glass composition, temperature and oxygen fugacity. These samples have then been characterized by SEM observation, EPMA measurements and UV-visible spectroscopy. Electrochemical measurements were performed in Cr2O3-rich melts in order to determine diffusion coefficient of Cr in the medium.

Keywords: chromia, molten silicates, dissolution

*Speaker