Oxygen Diffusion in Alumina. Application to Synthetic and Thermally Grown Al₂O₃

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18O diffusion coefficients have been determined in Al₂O₃ scales thermally grown on various Fe-20Cr-5Al steels with or without RE additions. The oxygen isotope profiles collected by SIMS allowed to determine bulk and grain boundary 18O diffusion coefficients. Previous two-stage oxidation experiments have been performed to determine the Al₂O₃ scale growth mechanism. It clearly appeared that a mixed anionic-cationic diffusion mechanism is responsible for the alumina scale growth on undoped FeCrAl and Zr-doped alloys. For the other doped specimen, oxygen diffusion was found to be predominant. The diffusion experiments were compared to kinetic tests performed under air in a thermobalance.

The role played by the reactive elements (Y, Zr, Hf, La, Ce,…) on the oxygen diffusivity will be discussed.

18O diffusion coefficients were also determined in synthetic alumina. Y-doped alumina powders were prepared via an humid route from a slurry of high purity α-Al₂O₃ powder and a nitrate solution. Samples were then CIPed and HIPed to get very dense translucent polycrystalline samples. The so-calculated 18O diffusion coefficients were compared to the coefficients determined on thermally grown alumina scales and to the data issued from the literature.

The final discussion will be focused on the possibility or not to compare accurately synthetic and thermally grown alumina to determine oxygen diffusion coefficients.