Boron extraction from liquid silicon by oxidation for photovoltaic applications

Mathieu VADON

Supervisors: Yves Delannoy, Guy Chichignoud

Monday, October 23rd 10:00 am

Room C111 (Phelma Campus)

Abstract: This thesis focuses on processes related to the extraction of boron from liquid silicon for the production of silicon pure enough to make photovoltaic cells. These processes involve the injection of $H_2O(g)$ or H_2- O_2 plasmas on electromagnetically stirred liquid silicon. A proper modeling is necessary for the purpose of optimization.

A computational fluid dynamics model that predicts accurately the purification speed has been made. This model is based on an analysis of thermodynamical data and on a monodimensional model of the gas boundary layer at the surface of the liquid silicon that takes into account the formation of silica aerosols. When the concentration of oxidant at injection increases, it speeds up the process and saves energy. However, when this concentration is too high, a silica layer appears on the liquid surface and stops the process. An empirical formula to predict the limit concentration has been validated but it can be explained only by estimating the kinetics of formation of silica aerosols.