APPLIED TRAVELLING MAGNETIC FIELD DURING SILICON SOLIDIFICATION IN A BRIDGMAN CONFIGURATION

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Silicon continues to be the most used material for the development of solar cells in the photovoltaic industry. Far from the performances of mono crystalline silicon obtained from expensive crystal growth methods like Czochralski method, the less expensive multi-crystalline silicon, obtained from a directional solidification process, is used as a base material for solar cells in order to keep a low production cost especially if the high performances of the cells are not the top priority. Metallurgical grade raw materials could provide an even lower production cost if the impurities distribution could be controlled during the process. In order to reach the best possible electrical performances for the cells, a reduced number of crystal defects as grain boundaries and dislocations is desired. The impurities are generally trapped at the grain boundaries, but they could also precipitate thus decreasing the quality of the solar cells. An option to overcome this problem without decreasing the growth rate is to induce a controlled fluid flow in the liquid. That could enhance the segregation and allows the imposing of a desired interface shape in a controlled manner.

A vertical Bridgman type furnace (VB2) equipped with an electromagnetic stirrer was developed in order to study the solidification process of Si under travelling magnetic field. The furnace was equipped with a Bitter type electromagnet that can provide a travelling magnetic field able to induce a convective flow in the liquid. As a result the axial segregation of metallic impurities is improved while controlling the interface deflection. A numerical model was developed in ANSYS Fluent commercial software to support and complete the experimental set-up. This paper presents experimental and numerical results of this approach.