Contribution ID: **130** Type: **Invited Lecture**

Some particularities of heat and oxygen transport in a 200mm Czochralski growth of silicon crystals

Thursday 10 July 2025 15:50 (25 minutes)

Nowadays Si-wafer based PV technology accounted for more than 95% of the total production. The market share of mono-crystalline technology is about 84% of total c-Si production. In order to meet the low-cost manufacturing criterion the Czochralski (CZ) crystal growth method which is the dominant technology for growing high quality monocrystalline silicon should be optimized. Defects and impurities incorporated in grown crystals during the growth process at the solid-liquid(S-L) interface limits the efficiency potential of the grown crystals because they reduce the minority carrier lifetime. The solar cell efficiencies achieved by the different techniques correlate directly with the material quality. Therefore, in order to increase the efficiency, a deep understanding of the underlying chemo-physical phenomena occurring during the crystallization process and their influence on the material properties is of utmost importance. Melt convection is acknowledged to be a very important factor in the field of crystal growth: Convective flows contribute to heat transfer and thus control the rate of solidification; The resulting temperature field in the vicinity of the S-L interface affects its shape and therefore the generation of thermal stress and the formation of dislocations; Convection controls the species transport in the melt; It affects the dissolution rate of crucible materials, It affects the formation and transport of particles in the melt; Furthermore, in a complex interaction of both heat and species transport, convection strongly influences the morphology and stability of the S-L interface. In a Cz process, time-fluctuations in temperature and in the concentration of impurities are mainly due to the melt convection with its two components: the natural convection and the forced convection generated by the rotation of the crystal and the crucible. In this contribution a numerical study using STHAMAS 3D software of the influence of different growth parameters (crucible and crystal rotations, pull rate) on the temperature and oxygen distribution will be presented for a 200mm Cz-configuration.

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Session Classification: Condensed Matter, Materials and Applied Physics

Track Classification: S03 –Condensed matter, Materials and Applied Physics