CZ 法におけるシリコン原料装填構造の 原料融解過程と炭素混入に対する影響

Effect of packing structure of Si chunks on melting process and carbon contamination in Czochralski silicon crystal growth

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Reduction of carbon (C) contamination in Czochralski silicon crystal growth (CZ-Si) is required for the production of Si wafer with long carrier lifetimes. Contamination of C in Si crystal mainly originates from carbon monoxide (CO) generation on the graphite components. Therefore, it is essential to control the CO generation and C incorporation from the preheating to the tailing processes. Loading a crucible by poly-Si charge includes many technique details for the optimization of melting and growth process [1].

Due to the porosity of packing Si chunks, the heat transport modeling should take into account the effective thermal conductivity (ETC) of Si feedstock. The ETC model proposed by IAEA [2] was applied in the transient global simulation of the melting process. The ETC could be affected by packing structures, as a function of chunk size and porosity. A top layer with the thickness of 50mm was set as the interest area. Comparison of melting processes with different packing structures indicated that smaller Si chunks packed in the upper part can reduce the heat loss from the top surface, as shown in Fig. 1. Moreover, the duration decrease of melting process is favorable for the reduction of C contamination in Si feedstock, as shown in Fig. 2. Optimization of the melting process by packing structure is possible and essential for C reduction.

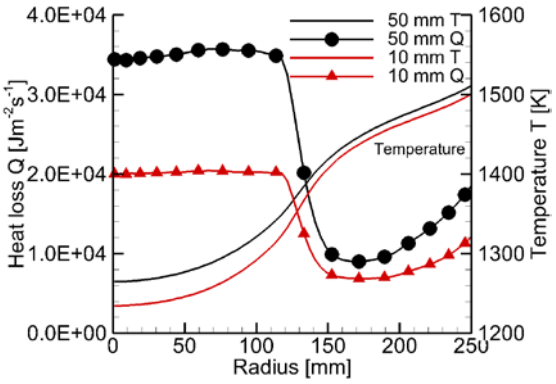

Fig. 1 Heat loss and temperature on top surface

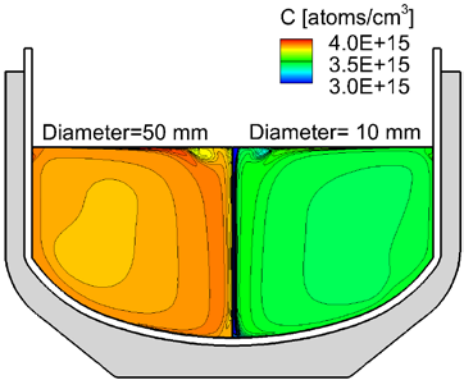

Fig. 2 C accumulation in Si feedstock

[1] U. Martini et al., U.S. Patent 20140060422 A1, March, 6, 2014.

[2] IAEA-TECDOC-1163, 2000, IAEA, Vienna.

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