# CZ 結晶成長法の原料融解過程における 坩堝移動法を用いた炭素混入制御

## Control of crucible movement on melting process and carbon contamination in Czochralski silicon crystal growth

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Contamination of carbon (C) in Czochralski silicon crystal growth (CZ-Si) mainly originates from carbon monoxide (CO) generation, which is triggered during the heating and melting stages. Axial movement of the crucible is generally applied to adjust the level of Si feedstock due to its volume shrinking during the melting and pulling process. Melting process, as well as the species transport, must be modeled by transient global simulation according to the crucible movement and the Si volume change.

Axial movements of the crucible and the melting of Si feedstock in CZ-Si crystal growth result in the dynamic thermal and flow field, as well as the affected species transport. Two cases with fixed or lifting crucible locations were investigated by the transient global simulation with dynamic mesh. The gap width between the gas-guide and the top surface of Si feedstock was kept constant during the lifting crucible process. Accumulations of C in Si feedstock were compared for the fixed and lifting crucible cases, as shown in Fig. 1. Lifting crucible with fixed gap width resulted in higher C accumulation due to the shorter distance for CO diffusion. Furthermore, different gap width cases with the lifting crucible were also investigated to clarify the control strategies of crucible movement on the C contamination in CZ-Si growth. It is found that optimum gap width for C reduction exists according to Pe number of gas flow and diffusion distance of CO, as shown in Fig. 2.

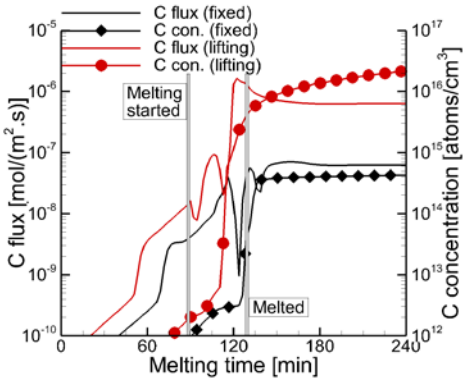


Fig. 1 C levels for fixed and lifting crucible cases

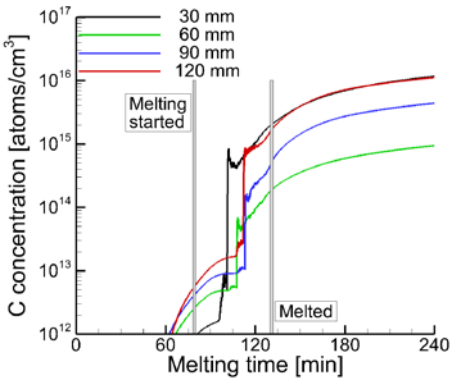


Fig. 2 C levels for different gap width cases

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