

Characterization of residual strain in seed-cast grown Si シードキャストシリコンインゴット中の残留歪の評価

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The seed-cast method has the big advantage of obtaining mono-Si ingots in an uncomplicated growth process. However, thermal stresses and the crucible constraint lead to high residual strain in the grown ingots, which can cause breakage during the handling and wafer fabrication process. It is of uttermost importance to analyze this residual strain and to find ways of eliminating and/or reducing stress during the crystal growth. In this study, the residual strain in seed-cast grown Si ingots was analyzed by SIRP^[1,2].

To understand in which process steps residual strain accumulates, several Si ingots were grown in a laboratory scale furnace ($\varnothing$ 10cm) using different cooling conditions after completion of the solidification. Crystal 1 was cooled at 12°C/min throughout the complete temperature range, Crystal 2 was cooled first at 12°C/min and later the cooling rate was lowered to 5°C/min below 900°C, and Crystal 3 was first slowly cooled with 5°C/min, which was changed to 12°C/min cooling below 900°C. The SIRP images of the crystals are shown in Fig. 1. It was found that the changes in cooling gradients greatly influenced the amount of residual strain. In comparison to Crystal 1, Crystal 2 shows a reduction in residual strain by over 30% [3]. In Crystal 3 the reduction is more than 70%. This result suggests that thermal stresses in the high temperature region greatly influence the amount of residual strain.

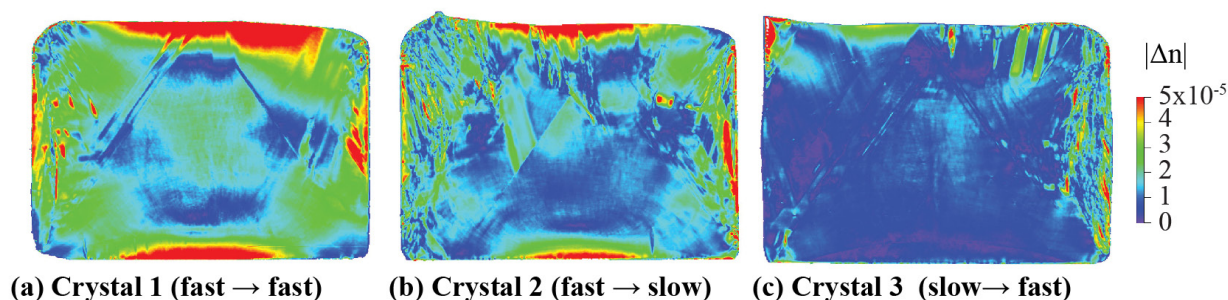


Fig. 1: SIRP images of the grown crystals

Reference:

- [1] M. Yamada, Rev. Sci. Instrum. 64(7) (1993) 1815-1821
- [2] M. Fukuzawa et al, J. Electrom. Materials 39 (2010) 700
- [3] K. Jiptner et al, physica status solidi (c) (2012) DOI10.1002/pssc.201200884, *in press*