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# NUMERICAL EXAMINATION AND VERIFICATION OF THE DIRECTIONAL SOLIDIFICATION OF SILICON PROCESS

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Polycrystalline semiconductor solar cell is the most potent energy generation method known. Recently investigators have examined the effects of heat flux on crystal growth. However, observation has indicated that the different geometric design in furnace can generate different heat flux in crucible. Therefore, the present study adopts company's chamber model and experimental properties to simulate producing big size polysilicon process by directional solidification method by 2-D time-dependent simulations using the custom software package written in Comsol Multiphysics. The Comsol was chosen because it can accurately couple thermal field and fluid field simultaneously despite the fact that the two fields interact with each other. Although this study has been unable to demonstrate that the argon flow in crucible, it just obviously affects the beginning of crystal growth in high temperature. To increase the reliability of simulation, the first case was identical to company's design and was compared to the temperature and crystal growth rate. In order to identify the effect of different types of design, the study used five methods to obtain better shape for melt/crystal interface. The first set of simulation examined the impact of crucible's heat transfer coefficient, when it larger, velocity of crystal growth became faster. In addition, radial crystal growth also increased because radial heat loss became larger. The second one was to open the insulation layer underneath the crucible. It could shorten the time being spent on crystal growth while the growth velocity was too fast which resulted in getting worse quality crystal. The third one was to set up heat insulation block on the crucible corner. It could slow down the flow velocity in the crucible on the corner. It also decreased radial crystal growth and no significant differences were found in the overall rate of crystal growth. The fourth one extended heat insulation support on the bottom of the crucible. One interesting finding is it kept warm and decreased temperature difference on the crucible side. Keeping side warm increased axial temperature gradient. Therefore, this design could attain the lowest Velocity/Gradient value without radial crystal growth. The last design combined third and fourth design. One unanticipated finding was that it would not accelerate lateral crystal growth because the fourth design could keep warm and transfer heat into the crucible. Nonetheless, the third design would block heat into crucible. Overall, these results indicate that extended heat insulation support on the bottom of the crucible has the best Velocity/Gradient value and shape for melt/crystal interface. However, more research on this topic needs to be undertaken before the association between design and heat flux is more clearly understood.