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Optimization of Czochralski Process (Cz) Process Using Cooling Tube Thermal Shield: Simulation Approach

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Abstract

Silicon wafers are the dominate materials in nowadays semiconductor industries. The most popular method to produce these wafers is known as Czochralski Process (Cz). For the first time, the cooling tube thermal shield is introduced in order to enhance the efficiency and productivity of Czochralski Process. In this new configuration the cold water flows to vicinity of crystal above the thermal shield. This increases the temperature gradient and subsequently increases the pulling speed. For this the three-dimensional energy equation, Navier stocks equation, moving mesh method and thermal stress model are fully coupled to determine wafer quality under the newly proposed thermal shield. Temperature distribution, melt and argon flow, crystal front shape and thermal stress are then obtained and investigated carefully. All results are compared between the original CZ process and the new version. The results showed that the crystal growth rate can be enhanced by new configuration about 25%. Additionally, the maximum thermal stress increases from 10MPa to ~20 MPa where still is under the critical value 25MPa. The simulation proved that the new CZ process shows a great potential to enhance the efficiency of silicon wafer production to a new level.

Keywords
Czochralski Process, simulation and modelling, Process optimization, and crystal growth.

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Biography
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