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Three-dimensional Steady Flow in Thin Annular Pools of Silicon Melt under a Magnetic Field

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Abstract : A three-dimensional (3D) numerical technique is used to investigate the possibility of reducing the price of manufacturing some silicon-based devices, particularly those in which minor temperature gradients can significantly reduce performance. The silicon melt under the magnetic field produces Lorentz force, which can effectively suppress the flow which is caused by temperature gradients. This might allow some silicon-based products, such as solar cells, to be manufactured using a less pure, and hence less expensive. The thermocapillary effect of the silicon melt flow in thin annular pools subjected to an externally induced magnetic field was observed. The results reveal that with a strong enough magnetic field, isothermal lines change form and become concentric circles. As the amplitude of the magnetic field (Ha) grows, the azimuthal velocity and temperature at the free surface reduce, and the asymmetric 3D flow becomes axisymmetric steady when Ha surpasses a threshold value.

Keywords : magnetic field, manufacturing, silicon melt, thermocapillary
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