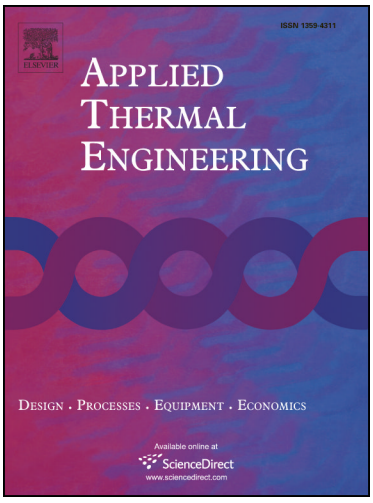

Research Paper

Thermocapillary flow and free-surface deformation of liquid bridge under different magnetic fields

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Thermocapillary flow and free-surface deformation of liquid bridge under different magnetic fields

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Abstract The effects of transverse and cusp magnetic fields have been conducted on the thermocapillary flow and free-surface deformation in a silicon liquid bridge. The volume of fluid (VOF) method is adopted to track the free-surface movement. Based on our numerical results, both the transverse and cusp magnetic fields have a remarkable suppressing effect on the thermocapillary flow and free-surface deformation. The suppressing effect is directional in the case of the transverse magnetic field. At θ=0° plane, the transverse magnetic field evidently suppresses the surface deformation near z=0.225 cm region when $B_{T0}\leq$0.1 T and starts to have the suppression effect near z=0.921 cm region when 0.1 T<$B_{T0}\leq$0.3 T. The deformation suppression performances at θ=90° plane are opposite to that at θ=0° plane. The critical Hartmann numbers for deformation damping on the θ=0° and θ=90° planes are 230.12 and 240.22, respectively. The cusp magnetic field causes concentration of the convection vortexes near the interface. Deformation suppression capability of cusp magnetic field is stronger than that of the transverse magnetic field. The critical Hartmann numbers for deformation damping on the θ=0° and θ=90° planes have the same value of 98.36 under the cusp magnetic field.

Keywords: thermocapillary flow, deformable free-surface, VOF, magnetic field, deformation damping