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Directional Solidification of Pb-Sn Alloys Affected by a Rotating Magnetic Field

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An experimental and numerical study with respect to the influence of a rotating magnetic field (RMF) on the directional solidification of a Pb-Sn alloys is reported. A cylindrical crucible with a diameter of 50 mm was positioned on a water cooled copper chill thus inducing an axial heat transfer from the mold. The electromagnetically driven convection shows a distinct effect on the solidification parameters such as the cooling rate, the temperature gradient or the growth velocity of the liquidus isotherm resulting in significant modifications of the observed macro- and microstructures. The fluid flow promotes the heat transfer rate and decreases the temperature gradients in the melt. Analyzing the columnar-equiaxed transition (CET) a dependence of the CET position and shape on the applied Taylor number was demonstrated. The experiments also revealed that the permanent modification of the fluid volume due to the movement of the solidification front prevents the development of stationary flow pattern as known for the isothermal case.

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