TOPICAL REVIEW

Texturing by cooling a metallic melt in a magnetic field

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Robert F Tournier and Eric Beaugnon
Centre National de la Recherche Scientifique, Consortium de Recherches pour l'Emergence de Technologies Avancées, B P 166, 38042- Grenoble Cedex 09, France
E-mail: Robert.Tournier@grenoble.cnrs.fr

Abstract. Processing in a magnetic field leads to the texturing of materials along an easy-magnetization axis when a minimum anisotropy energy exists at the processing temperature; the magnetic field can be applied to a particle assembly embedded into a liquid, or to a solid at a high diffusion temperature close to the melting temperature or between the liquidus and the solidus temperatures in a region of partial melting. It has been shown in many experiments that texturing is easy to achieve in congruent and noncongruent compounds by applying the field above the melting temperature T_m or above the liquidus temperature of alloys. Texturing from a melt is successful when the overheating temperature is just a few degrees above T_m and fails when the processing time above T_m is too long or when the overheating temperature is too high; these observations indicate the presence of unmelted crystals above T_m with a size depending on these two variables that act as growth nuclei. A recent model that predicts the existence of unmelted crystals above the melting temperature is used to calculate their radius in a bismuth melt.

Keywords: magnetoscience, magnetic processing, nucleation, magnetic texturing, undercooled liquids, intrinsic nuclei, magnetic susceptibility, metallic melt, crystallization

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