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Texture and its Impact on Thermal Conductivity in Miscibility Gap Alloys

Miscibility Gap Alloys (MGA) are a new type of latent heat Thermal Energy Storage (TES) material that takes advantage of a miscibility gap between two elements or compounds, often metals or semi-metals. MGA encapsulate a distributed fusible phase for latent heat storage inside a matrix phase. Their storage capacity is dominated by the included phase but their high thermal conductivity is mainly a function of the matrix.

Many MGA are made with a graphite matrix due to its excellent thermal properties and its chemical stability with a host of materials. However, graphite crystals are highly anisotropic, so bulk graphite samples are susceptible to anisotropy, or "texture". This can occur naturally, or through the deliberate manipulation of the material in the manufacturing technique (e.g. using powder metallurgy techniques). It is possible to obtain much higher or lower properties (such as thermal conductivity) in a desired direction; however, the perpendicular direction(s) will experience the opposite effect. When a material is only required to perform a function in one or two directions (e.g. radial heat transfer), anisotropy can be beneficial.

This work investigates the presence, effect and manipulation of texture in MGA samples with a graphite matrix based on varying manufacturing techniques, and its impact on thermal conductivity. Neutron diffraction is used to measure the texture within graphite matrix MGA. Direct measurement of thermal conductivity will then allow us to validate current texture to thermal conductivity correlations. Finally, this knowledge of anisotropic thermal conductivity within the MGA will allow for optimal placement of heat transfer piping and layout of the material within storage blocks, among other advantages.

Topic

Advanced Materials

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