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# Identifying growth twinning of $\beta(\text{In})$ phase during rotating directional solidification of the $\beta(\text{In})$ - $\text{In}_2\text{Bi}$ - $\gamma(\text{Sn})$ eutectic system

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## Abstract

Understanding the origins of growth twins in materials is essential as the reorientation of the crystal and introduction of twin boundaries affect material's properties. Two examples for growth twins are feathery grains observed in nonfaceted alloys, such as aluminum, as well as twins in faceted crystals. It is known that formation of growth twins is promoted by high thermal gradient, lack of inoculants, minimum concentration of solute elements, and high entropy of fusion. In this work, we present growth twins in body-centered-tetragonal  $\beta(\text{In})$  phase in the ternary eutectic alloy In-20.7Bi-19.1Sn (at.%) during solidification. This alloy solidifies with three solid phases  $\beta(\text{In})$ ,  $\text{In}_2\text{Bi}$ , and  $\gamma(\text{Sn})$ , displaying coupled eutectic growth. We used rotating directional solidification (RDS) to *in-situ* observe the growth dynamics and pattern formation. Samples are thin films, prepared by pressure filling of custom-made glass cells. After solidification, EBSD maps were taken from the samples by removing the glasses and exposing it directly to the electron beam without any grinding and polishing that may induce deformation twins. We identified systematic growth twins of the nonfaceted body-centered-tetragonal  $\beta(\text{In})$  phase in different eutectic grains, which were not feathery grains. Hence, we introduce a new type of growth twin which is not promoted by any of the known parameters listed above and open a discussion on a link between the rotation of the sample during directional solidification and formation of these twins. We discuss twinning in relation to the crystal orientation relationships and the anisotropy of phase boundary energy.

**Keywords:** Growth twin, Rotating directional solidification, EBSD, Solidification microstructure, Eutectic alloys

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