

An Indian-Australian research partnership

Recrystallization texture development in materials with hexagonal crystal structure - experimental study and Monte-Carlo simulations

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The problem

The control of texture evolution due to recrystallization in materials with a hexagonal close packed structure because of the anisotropic nature of the mechanical properties of these materials. Recrystallization is one way by which the anisotropy can be controlled and potentially restricted. However, before any control can be exercised there are several questions that have yet to be answered for hexagonal materials. These include the relative role of continuous and discontinuous recrystallization in forming the final microstructure; the role of twins for grain refining; and the influence of boundary properties on the final texture and microstructure. The proposed research program will address these questions with a combination of experiment and computer modelling.

The project

Monte Carlo (MC) modelling is typically used to simulate the microstructural evolution during recrystallization of metals and contributes to a better understanding of the mechanisms by which recrystallization occurs. While well developed for cubic crystal structures, there are few detailed models for hexagonal structures. Model frameworks established for cubic materials will be modified to account for the anisotropy of grain boundary properties, which in turn plays an important role in texture development. The necessary experimental information will be obtained using Electron Back Scattered Diffraction, which allows us to obtain information such as stored energy, texture, and misorientation at the local (grain and subgrain) scale. A novel feature of this program is that it will use the phase field technique to simulate the early stages of recrystallization, and this will be coupled to the meso-length scale Monte Carlo simulation. Outputs of the model – such as pole figures, orientation distribution functions (ODFs), boundary-misorientation distribution function, and volume fractions of specific texture components – will be compared to experimental information in order to validate the assumptions made about the mechanism of recrystallization.