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Modeling the Crystallographic Texture Evolution Based on the Maximum Entropy Method

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The distribution of crystal orientations is an important microstructural feature which affects the overall properties of polycrystalline metals. Phenomenological models seem to be generally unable to adequately represent the evolution of the crystallite orientation distribution. Therefore, if the evolving texture has to be taken into account in the context of finite element simulations, e.g. of deep drawing processes, in most cases mixture theories (Taylor, Sachs) are applied. The disadvantage of such an approach is that at each integration point of the finite element mesh, large systems of (algebro-)differential equations have to be integrated. We present an alternative approach that is based on a tensorial Fourier expansion of the crystallite orientation distribution function (CODF) [Adams et al. 1992, Böhlke and Bertram 2003], which is the one-point correlation function of crystal orientations. The general evolution equations for the Fourier coefficients are derived. The evolution equations contain only microscopic parameters. By this approach the texture evolution can be described by modeling some low order Fourier coefficients and by estimating the higher-order coefficients based on the maximum entropy method. It will be shown that such a low dimensional approach of the CODF yields a reasonable description of the texture evolution and represents a versatile alternative to the above mentioned mixture theories.

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