Atlas of Yield Surfaces for Strongly Textured FCC Polycrystals

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Abstract. It is well proven that the mechanical properties of sheets and extrusions of metals, typically aluminium alloys and steels, are strongly correlated with the microstructure and crystallographic texture – i.e. the size, shape and orientation of the crystals in the material – which in turn depend on the thermo-mechanical process history of the product. Most of the sheets and extrusions have predominant crystallographic orientations with small or large scatter around them. Post heat-treatment, e.g. annealing, may change the texture if recrystallization occurs in the material. Textures are usually defined as composed of different generic texture components. Mechanical plastic anisotropy, geometrically presented by the shape of the yield surface, is sensitive to texture and grain shape. Many phenomenological yield criteria have been proposed, e.g. non-quadratic formulations or functions based on one or several linear transformations. These models are often calibrated using experimental data. Another complementary approach consists in using lower-scale models such as the crystal plasticity. To represent explicitly both microstructure and crystallographic texture, the latter is combined with the finite element method (CP-FEM). A discrete yield surface may then be generated by loading a representative volume element (RVE) along different strain paths. The aim of the study reported here is to generate discrete yield surfaces and calibrate the yield criterion Yld2004-18p for typical generic texture components found in aluminium alloys. To achieve this, a workflow has been established which consists in a texture generator, the open source software package DREAM.3D, a discrete yield surface generator using CP-FEM and a calibration software.