MULTI-SCALE MODELLING OF THE SPATIAL DISTRIBUTION OF DEFORMATION TEXTURES IN SHEET METAL FORMING. EXPERIMENTAL VALIDATION: CUP DRAWING OF STEEL.

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Abstract. In this paper we present a study of the textures which develop in different locations during a cup drawing process applied to low carbon steel. These textures have been experimentally measured, but have also been predicted by a multi-scale model. This model spans several length scales from the macroscopic deformation of the workpiece to the microscale interactions between individual grains in a polycrystalline material. The macroscopic behaviour of the material is described by means of a Finite Element (FE) model. Plastic anisotropy is taken into account by a constitutive law (Facet) which was been identified by using a two-scale model (ALAMEL) connecting the macro-scale (i.e. a polycrystal with several thousands of grains) with the meso-scale (grain level). The ALAMEL model was used for two purposes: (i) updating the deformation texture (ii) identification of the coefficients of the "Facet" constitutive model. The overall organisation of the finite element calculation, including aspects such as parallelisation and the process of choosing the strain levels at which texture updating is carried out in the integration points, is explained in a different contribution. The present contribution focuses on the comparison between predicted and measured textures in various regions of the drawn cup, and how this field of textures contributes to the heterogeneity of the anisotropy of the metal throughout the workpiece. This may not be so important for a drawn cup, but it is clear that the "cup drawing process" is used here as a simplified model process in sheet metal forming in general..