

Modelling of texture evolution and grain refinement in metals and alloys of high specific strength in SPD processes.

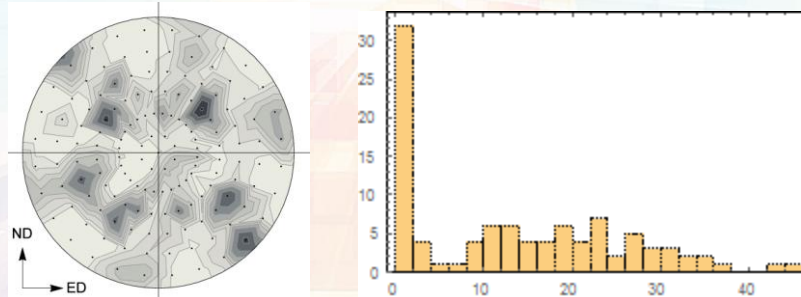
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Texture evolution and grain refinement in materials subjected to severe plastic deformation (SPD), in particular the ECAP and KoBo extrusion [1] processes are examined in this work. The well known ECAP process consists in extruding a billet through an angular channel [2]. In the KOBO process material is extruded with assistance of cyclic rotation of a die. Both processes lead to considerable grain refinement and often to strong texture evolution [2,5].

The VPSC code [4] itself provides different variants of self-consistent (SC) micro-macro transition scheme. It was combined with the proposed crystal plasticity framework [3] and has been used to simulate texture evolution in [5]. However, this model is two-scale and does not predict the grain refinement. In order to examine the latter phenomenon three-scale model of microstructure evolution was developed. The model is able to combine two micro-macro transition schemes to simulate the evolution of orientations inside a grain and decide if the formation of subgrains has occurred. Example of results in terms of texture and misorientation angle distribution for fcc material subjected to ECAP process is shown in Fig 1. The validity of modelling



approach is discussed.

Fig 1. Simulated pole figure and misorientation distribution after four ECAP passes in route Bc. Three-scale model with Taylor and SC scale transition schemes

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Literature

- [1] A. Korbel and W. Bochniak (1995). *J. Mat. Proc. Technol.* **53**, 229 -237.
- [2] I. J. Beyerlein and L. S. Toth (2009). *Progress Mater. Sci.* 54 427-510.
- [3] K. Kowalczyk-Gajewska (2011). *Micromechanical Modelling of Metals and Alloys of High Specific Strength*, IFTR Reports, Warsaw.
- [4] R. A. Lebensohn and C. N. Tome (1993) *Acta Metall. Mater.* **41**, 2611-2624.

- [5] K. Kowalczyk-Gajewska, S. Stupkiewicz, K. Frydrych and H. Petryk (2014). *IOP Conf. Ser.: Mater. Sci. Eng.*, **63**, 012040-1-10.

