## [SY-A4]Symposium A-4

Chair: David L McDowell(Woodruff School of Mechanical Engineering, Georgia Institute of Technology, United States of America)

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# [SY-A4]A new E-VPSC polycrystal formulation: fundamentals

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Effective medium polycrystal models provide a computationally efficient tool for simulations of elastic and visco-plastic deformation of aggregates. In particular, visco-plastic self-consistent (VPSC) schemes have been widely and successfully applied to predictions of texture, stress-strain, and dislocation density evolution during large strain deformation. In addition, VPSC schemes have been implemented in finite element codes as material subroutines to simulate various metal forming operations. However, a limitation of VPSC models is that they only address deviatoric stress and strain and neglect elastic contributions. As a consequence, they cannot be used to predict internal Cauchy stress evolution (as measured with neutron or X-ray diffraction), or to study constitutive behavior during complex loading scenarios (such as Bauschinger or spring-back) where the contribution of elasticity needs to be accounted for.

Several formulations have been proposed in the last 20 years that empirically combine visco-plastic and elastic regimes to formulate elasto-visco-plastic (E-VPSC) effective medium models. A disadvantage of these formulations is that they increase considerably the computation time, which makes them unwieldy for using in forming simulations.

Here we present a new approximate E-VPSC formulation that, by treating elasticity as a perturbation to the VPSC scheme of Lebensohn and Tomé [1], seems to capture the best of both worlds: efficient numerical processing while providing access to the evolution of Cauchy stress in the grains.

In this presentation we describe such E-VPSC formulation, compare it to previous ones, and provide a simple application - based on Voce hardening - to predictions of stress strain and internal stress evolution in steel subjected to tension-compression reversal tests. In a companion paper [2] we present several applications of this new E-VPSC formulation.

[1] R.A. Lebensohn, C.N. Tomé, “A self-consistent anisotropic approach for the simulation of plastic deformation and texture development of polycrystals: application to zirconium alloys”, Acta Metallurgica et Materialia 41(9) (1993) 2611-2624

[2] Y. Jeong, C.N. Tomé, “A new E-VPSC formulation: applications”, this conference