Homogenization of layered materials with rigid components in single-slip finite plasticity

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This talk reports on first progress toward a better quantitative understanding of the effective behavior of polycrystals in the framework of geometrically nonlinear plasticity. Precisely, we study a variational model for plastic material composed of fine parallel layers of two types. While one component is completely rigid in the sense that it admits only local rotations, the other one is softer featuring a single active slip system with linear self-hardening. As a main result, explicit homogenization formulas are determined by means of Γ-convergence. Due to the anisotropic nature of the problem the findings depend critically on the orientation of the slip direction relative to the layers. We observe three qualitatively different regimes involving macroscopic shearing and blocking effects. Technical difficulties in the proofs are rooted in the intrinsic rigidity of the model, which calls for new rigidity estimates as well as a careful analysis of the admissible microstructures restricted by differential inclusions.