On the homogenization of metal matrix composites using strain gradient plasticity - DTU Orbit (22/12/2018)

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The homogenized response of metal matrix composites (MMC) is studied using strain gradient plasticity. The material model employed is a rate independent formulation of energetic strain gradient plasticity at the micro scale and conventional rate independent plasticity at the macro scale. Free energy inside the micro structure is included due to the elastic strains and plastic strain gradients. A unit cell containing a circular elastic fiber is analyzed under macroscopic simple shear in addition to transverse and longitudinal loading. The analyses are carried out under generalized plane strain condition. Micro-macro homogenization is performed observing the Hill-Mandel energy condition, and overall loading is considered such that the homogenized higher order terms vanish. The results highlight the intrinsic size-effects as well as the effect of fiber volume fraction on the overall response curves, plastic strain distributions and homogenized yield surfaces under different loading conditions. It is concluded that composites with smaller reinforcement size have larger initial yield surfaces and furthermore, they exhibit more kinematic hardening.

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