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Thickness Dependent Yield Strength of Thin Films

Peter Gudmundson, Per Fredriksson

Royal Institute of Technology, Stockholm, Sweden

Experiments have showed that the yield strength and hardening of thin films may depend on the film thickness. This thickness dependence cannot be explained by standard local plasticity or viscoplasticity theories. Micro structural length scales must be taken into account. There are several ways to incorporate micro structural length scales. Gudmundson has presented a theoretical framework that covers some of alternative theories as special cases. A particular feature of this theory is that the structural dimension influences both the elastic range and the hardening. The theory is implemented in a finite element programme and it is demonstrated by application to two thin film problems. A thin film on a thick elastic substrate is considered. Firstly, the film is subjected to a pure shear loading. Secondly, a prescribed biaxial strain of the film-substrate is considered. The results are compared to experiments and alternative models.

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