Wang, Y.; **Weissmüller, J.**; **Duan, H. L.**
Mechanics of corrugated surfaces. (English) Zbl 1200.74008
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Summary: Experimental studies of the surface stress of solids typically work with surfaces that are not perfectly planar. The experiment then probes an effectively averaged surface stress. The evolution of the surface morphology, for instance during film growth or reconstruction, is also affected by the surface stress acting on a corrugated surface. Here, we analyze the mechanics of rough surfaces in a continuum framework. In a generalization of the approach of *J. Weissmüller* and *H. Duan* [Phys. Rev. Lett. 101, 146102 (2008; doi:10.1103/PhysRevLett.101.146102)] to solids with anisotropic elasticity, anisotropic surface stress and anisotropic roughness, we focus on the effectively averaged surface stress that determines the mean compensating stress in the bulk. Important concepts are the projection of out-of-plane stresses at inclined segments of a surface into the macroscopic surface plane, and the transverse coupling between the out-of-plane and in-plane components of the surface-induced stress in the bulk. We show that the coupling of the surface stress at a corrugated surface into a planar substrate depends on the geometry of the corrugation exclusively through the surface orientation distribution function. Special geometries are inspected with an eye on illustrating the impact of anisotropic elasticity as well as geometric anisotropy, which both feed into the anisotropy of the effective surface stress.

MSC:

74A50 Structured surfaces and interfaces, coexistent phases

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