Chen, T.; **Dvorak, G. J.**; **Yu, C. C.**

Size-dependent elastic properties of unidirectional nano-composites with interface stresses.

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Summary: Surfaces and interfaces in solids may behave differently from their bulk counterparts, particularly when the geometry is on the nanoscale. Our objective is to assess the overall behavior of composites containing cylindrical inclusions with surface effects prevailing along the interfaces. In the formulation, we first decompose the loadings into three different deformation modes: the axisymmetric loadings, the transverse shear and the antiplane shear. For each deformation mode, we derive the energy potential incorporating the surface effects. Using a variational approach, we construct the Euler-Lagrange equation together with the natural transition (jump) conditions. The surface effects are represented by an interface of a membrane type, with in-plane moduli different from those of either phase. The overall elastic behavior of the composite is characterized by five constants. Four of them, except the transverse shear modulus, are derived in simple closed forms using an approach of neutral inclusion. For the transverse shear, we derive the value based on the generalized self-consistent method.

MSC:

74E30 Composite and mixture properties
74Q15 Effective constitutive equations in solid mechanics

Keywords:

energy potential; variational approach

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References:

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