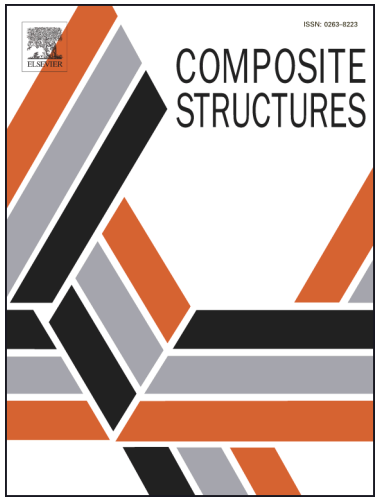

Buckling of a piezoelectric nanobeam with interfacial imperfection and van der Waals force: Is nonlocal effect really always dominant?

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Buckling of a piezoelectric nanobeam with interfacial imperfection and van der Waals force: Is nonlocal effect really always dominant?

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Abstract. With the development of NEMSs (nano-electro-mechanical systems), the size-dependent behavior has been an active topic. The scale parameter seems an essential factor dominating mechanical behavior at nanoscale. However, is it always dominant? This is a question deserving careful investigation. For this reason, the buckling of a bi-layered PE (piezoelectric) nanobeam is analyzed. The main purpose is to reveal and compare the effects of the nonlocal scale, imperfect interface, interlaminar van der Waals force and loading ratio. The imperfect interface is modeled by normal and shear springs, and the van der Waals force is represented by the Hamaker formula. Based on the principle of virtual work, the analytical solution of the critical buckling loading is derived by using the trigonometric shear deformation theory. After the verification in some degenerated cases, parametric studies are conducted. It is indicated that if the nonlocal parameter varies in the typical range [0, 4nm^2], it only has quite limited effect on the buckling behavior, as compared with the other three factors. In this case, although the buckling relies on the nonlocal scale, it is far more dependent on the conventional non-nanoscale factors. The conclusions can provide references for optimal design of NEMSs.

Keywords: Nano-electro-mechanical systems; Nonlocal piezoelectric nanobeam; Buckling; Imperfect interface; van der Waals force.

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