Effect of Geometry in Frequency Response Modeling of Nanomechanical Resonators - DTU Orbit (09/11/2017)

Effect of Geometry in Frequency Response Modeling of Nanomechanical Resonators

The trend towards nanomechanical resonator sensors with increasing sensitivity raises the need to address challengesencountered in the modeling of their mechanical behavior. Selecting the best approach in mechanical response modelingamongst the various potential computational solid mechanics methods is subject to controversy. A guideline for theselection of the appropriate approach for a specific set of geometry and mechanical properties is needed. In this study, geometricallimitations in frequency response modeling of flexural nanomechanical resonators are investigated. Deviation ofEuler and Timoshenko beam theories from numerical techniques including finite element modeling and Surface Cauchy-Borntechnique are studied. The results provide a limit beyond which surface energy contribution dominates the mechanical behavior.Using the Surface Cauchy-Born technique as the reference, a maximum error on the order of 50 % is reported forhigh-aspect ratio resonators.

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