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Effects of structure design on electrostatic pull-in voltage of perforated nanoswitch with intermolecular surface forces

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Abstract : In this paper, we model and investigate the electrostatic pull-in instability of a perforated cantilever nanoswitch subjected to van der Waals and Casimir forces. The nanocantilever is a beam structure perforated with a periodic square holes network, which has been considered as an electrode material for this new structure. Closed-form solutions for the critical pull-in parameters are derived from the standard deformation beam equation, in which an equivalent bending stiffness is considered due to presence of square holes network. The electrostatic and dispersion forces are included by modifying the standard deformation beam equation, while the small scale effect is introduced by using the Eringen's nonlocal elasticity theory. Pull-in parameters analysis of the perforated nanoswitch indicated that both pull-in voltage and pull-in deflection are affected by the gap ratio as well as the hole size ratio and the number of holes along the section of perforated nanocantilever beam. Therefore, these results are compared with literature results where new remarks are deduced and presented with detailed discussion for a proper design and investigation of M/NEMS nanoswitches.

- KEYWORDS : Cantilever nanoswitch ; Pull-in instability ; Periodic square holes ; Equivalent parameters ; Nonlocal parameter