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标题: Study of terahertz wave propagation properties in nanoplates with surface and small-scale effects
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来源出版物: INTERNATIONAL JOURNAL OF MECHANICAL SCIENCES 卷: 64 期: 1 页: 221-231 DOI: 10.1016/j.ijmecsci.2012.06.012 出版年: NOV 2012
在 Web of Science 中的被引频次: 0
被引频次合计: 0
引用的参考文献数: 69
摘要: In macroscopic and even microscopic structural elements, surface effects can be neglected and classical theories are sufficient. As the structural size decreases towards the nanoscale regime, the surface-to-bulk energy ratio increases and surface effects must be taken into account. In the present work, the terahertz wave dispersion characteristics of a nanoplate are studied with consideration of the surface effects as well as the nonlocal small-scale effects. Nonlocal elasticity theory of plate is used to derive the general differential equation based on equilibrium approach to include those scale effects. Scale and surface property dependent wave characteristic equations are obtained via spectral analysis. For the present study the material properties of an anodic alumina with crystallographic of < 111 > direction are considered. The present analysis shows that the effect of surface properties on the flexural waves of nanoplates is more significant. It can be found that the flexural wavenumbers with surface effects are high as compared to that without surface effects. The scale effects show that the wavenumbers of the flexural wave become highly non-linear and tend to infinite at certain frequency. After that frequency the wave will not propagate and the corresponding wave velocities tend to zero at that frequency (escape frequency). The effects of surface stresses on the wave propagation properties of nanoplate are also captured in the present work. 
入藏号: WOS:000311016300019
语种: English
文献类型: Article
作者关键词: Nanoplate; Nonlocal elasticity; Spectrum; Dispersion; Wavenumber; Surface properties
KeyWords Plus: WALLED CARBON NANOTUBES; NONLOCAL CONTINUUM-MECHANICS; DEPENDENT ELASTIC PROPERTIES; REFINED PLATE-THEORY; NANOELECTROMECHANICAL SYSTEMS; BUCKLING ANALYSIS; THIN CRYSTALS; FILMS; VIBRATION; STRESS
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出版商: PERGAMON-ELSEVIER SCIENCE LTD
出版商地址: THE BOULEVARD, LANGFORD LANE, KIDLINGTON, OXFORD OX5 1GB, ENGLAND
Web of Science 类别: Engineering, Mechanical; Mechanics

研究方向: Engineering; Mechanics
IDS 号: 036HF
ISSN: 0020-7403
29 字符的来源出版物名称缩写: INT J MECH SCI
ISO 来源出版物缩写: Int. J. Mech. Sci.
来源出版物页码计数: 11