Free vibration behaviour of rotating porous micro-disk made of functionally graded material

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Abstract: Due to the advancements in micro-fabrication technology, micro- and nano-size components are being widely used in various engineering applications, such as, use of micro-disk in micro engines for power genera on, micro-propulsion in aerospace, and micro-motors for robotic and biomedical applications. Most important analysis of a rotating micro-disks is free vibration analysis. However, classical continuum mechanics cannot include size effects of micro- and nano-scaled structures whereas non-classical modified couple stress theory (MCST) [1] can resolve this problem. For the current study, functionally graded materials (FGM), which are far superior to conventional composites, has been considered. Porosity in these materials offer multi-functionality and weight reduction compared to nonporous materials. However, free vibration analysis of the porous FGM micro disk is challenging work. For the present work, an annular rota ng micro-disk of uniform thickness is considered where the inner radius is clamped and the outer radius is free. The effect of porosity has been included through different material parameter. The model is validated against literature, and results for the first four modes are presented in non-dimensional speed–frequency plots for varying size and gradation parameters.

References[1]. H. Liu, C. H. Pan and P. Liu, "Dimension effect on mechanical behaviour of silicon micro-can lever beams, Measurement", 41, 885-895 (2008).