Sensors and Materials, Vol. 18, No. 7 (2006) 381–393
MYU Tokyo

S & M 0657

Experimental Study on Squeeze Film Damping of Perforated Micromechanical Structures Oscillating Perpendicular to the Substrate

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(Received July 11, 2006; accepted September 29, 2006)

Key words: microdamping, squeeze film damping, perforated plate, matched-asymptotic-expansions, edge effect

In this study, we investigate the squeeze film damping of a perforated planar micromechanical structure that oscillates in the normal direction to the substrate. We focus on the experimental data regarding the squeeze film damping compared with theoretical models based on matched-asymptotic-expansions, in terms of the size and number of perforations. A set of ten different structures, having three different sizes and different numbers of perforations, has been fabricated and tested. The experimental *Q*-factors, measured from the fabricated structures, are compared with two different theoretical values, estimated by finite element analysis (FEA) and matched-asymptotic-expansions. It is found that FEA overestimates the experimental values of the *Q*-factors by up to 150%. This major discrepancy is caused by the inaccuracy of the zero pressure boundary condition along the perforated edges. The values obtained from the matched-asymptotic-expansions, assuming nonzero pressure along the edges of the plates, are in good agreement with the experimental values within 20% margin of error.

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