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Energy dissipation in a fluidic nanomechanical resonator JOHN SADER, The University of Melbourne, THOMAS BURG, SCOTT MANALIS, Massachusetts Institute of Technology — The fluid-structure interaction of resonating microcantilevers in fluid has been widely studied and is a cornerstone in nanomechanical sensor development. Operation in fluid environments presents significant challenges due to the strong enhancement of fluid damping effects with miniaturization. Recently, Burg et al. [Nature, Vol. 446, 1066 (2007)] proposed a new type of microcantilever device whereby a microfluidic channel was embedded inside the cantilever, which resulted in unprecedented sensitivity. We study the fluid dynamics of these devices by presenting a theoretical model and experimental measurements. Significantly, it is found that energy dissipation in these devices is not a monotonic function of fluid viscosity. A direct consequence is that miniaturization does not necessarily result in degradation in the quality factor, which may indeed be enhanced. This highly desirable feature is unprecedented in current nanomechanical devices and permits direct miniaturization to enhance sensitivity in liquid environments.

John Sader
The University of Melbourne

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