Thermal elastic loss observed in a high Q mechanical oscillator

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The internal friction of the resonant modes of a single-crystal silicon double paddle oscillator have a characteristic temperature dependence, decreasing rapidly as the temperature is decreased from room temperature to about 100K and then exhibiting a featureless plateau as the temperature is further decreased to .5K. The loss at high temperatures (above 100 K) is found to be in agreement with a theoretical prediction of loss arising from thermal-elastic dissipation due to transverse thermal currents. The theory employs a combination of finite element and analytical models, and can be used to predict the loss factor arising from such thermal currents generally. The importance of this dissipation mechanism as a function of scale is briefly discussed.

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