Thermoelastic damping in micromechanical resonators\textsuperscript{1} THOMAS METCALF, BRADFORD PATE, DOUGLAS PHOTIADIS, BRIAN HOUSTON, Naval Research Laboratory — The performance of micro- and nano-mechanical resonators as sensors, filters, and in other devices is determined by the quality factor, $Q$, which measures the fractional energy loss per oscillation cycle of the resonator. In any given resonator, several energy loss mechanisms are likely to be simultaneously present. However, for micro- and nano-scale resonators, the relative strengths and identity of these mechanisms is largely unknown. We measure the temperature dependence of $Q^{-1}$ of two resonant modes (460 kHz and 510 kHz) of a 1.5 $\mu$m thick silicon micromechanical plate resonator. In-situ ultra-high vacuum annealing lowers the background energy loss at 120 K to $Q^{-1} \leq 5 \times 10^{-7}$. The $Q^{-1}$ increases with increasing temperature by different rates for the two modes, quantitatively agreeing with a modification of Zener’s theory of thermoelastic damping. This provides strong evidence that thermoelasticity is the dominant energy loss mechanism in one resonant mode.

\textsuperscript{1}Work supported by the Office of Naval Research.