Work to heat conversion in atomic springs

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Mechanical work to heat conversion is a familiar phenomenon from everyday life, as well as a central process of energy loss in any mechanical device. However, it is not clear how mechanical work is converted to heat at the atomic scale. Here, we propose to reveal the properties of mechanical work conversion to heat in metallic atomic contacts and atomic chains. Using thermal noise measurements, we will probe local temperature changes under repeated elastic and plastic deformation of atomic-scale contacts between two metal tips. We will use a mechanically controllable break junctions system to fabricate either different contacts of several dozens of atoms in diameter down to a single atom or elongate atomic chains between atomically sharp metal tips. We will study the role of system size, injected energy magnitude, elastic vs. plastic deformation, and metal type. This research is expected to shed light on the interplay between mechanical work and heat dissipation at the atomic scale, which is central for any nano-mechanical system.