Title:	Low Temperature Dissipation Scenarios in Palladium Nano-mechanical Resonators
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Abstract:	Below 4.2K most materials except liquid helium freeze. Even at these temperatures one sees thermal, acoustic and mechanical properties of matter change vibrantly as a function of temperature. In perfect solids there must be nearly zero dissipation as one approaches zero temperature,but there are always defects, grain boundaries, contamination etc., that cause change in mechanical systems at ultra low temperatures. A simple phenomenological model involves assuming there are two level systems (TLS) that couple to phonons and cause the solids to dissipate energy. There is a whole body of data on bulk properties of solids explained in the scope of TLS models. Especially interesting is glass like behaviour shown by both amorphous and crystalline solids. Nano-mechanical resonators are miniature analogues of bulk resonant structures like bridges spring boards etc. These systems have also shown characteristic features of TLS. In this thesis we investigate Palladium (Pd) nano-mechanical resonators that are few microns long and (200 □ 400) nm wide and 80 nm thick. Metallic resonators are slightly simpler systems than hybrid metal dielectric multi-layers. We chose Pd as a model system where we can change its intrinsic elastic properties drastically with addition of hydrogen (H2), as H2 adsorbed in Pd produces a compressive stress. We probe the response of these beams in the tensile limit due to relative thermal contraction of the substrates at cryogenic temperatures below 4:2 K typically 150 mK to 1:5 K as well as in a softer limit when the system was exposed to H2 exchange gas. The goal of this study is to modify the TLS landscape with strain introduced by adding H2. We discuss detailed data sets with and without H2 in the context of TLS phenomenology.
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