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Controlling the electrical impedance of nanomechanical oscillators by electromigration FENGPEI SUN, JIE ZOU, HO BUN CHAN, The Hong Kong University of Science and Technology — Detection of nanomechanical motion is of fundamental and practical interests. For doubly clamped nanobeams, a common method is the magnetomotive reflection technique. However, this technique usually suffers from large signal background due to the mismatch of the electrical resistance (R_e) of the oscillators to the impedance (50ohm usually) of the cables for detection. The large signal background precludes the possibility of driving the device into self-sustaining oscillations using a phase-locked loop. We develop a reproducible method of minimizing the signal background in the magnetomotive reflection technique. A gold nanowire with a junction in the middle is fabricated on the top of a doubly-clamped SixNy nanobeam via e-beam lithography. By passing a large direct current through the nanowire, migration of the gold atoms around the junction is activated due to the heat dissipated. An analog feedback loop is designed to maintain a stable process of electromigration until the target R_e is reached. Initially R_e is smaller than 50ohm. The motional impedance of the nanowire shifts the total impedance closer to 50ohm so that the resonance of the nanobeam appears as a dip on a large background in the amplitude spectrum. As R_e is increased to near 50ohm, the background reaches a minimum, and the resonance of the nanobeam turns into a peak. Self-sustaining oscillations of the nanobeam are successfully achieved via a phase-locked loop in this case. As R_e is further increased, the background becomes higher again. The dependence of the background signal on R_e agrees with calculations.

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