*Sensors and Materials,* Vol. 20, No. 2 (2008) 71–86
MYU Tokyo

S & M 0706

# FEM Simulation and Optimization of the Electromechanical Behavior of a Variable Superconducting Niobium Capacitor

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(Received September 18, 2007; accepted March 27, 2008)

***Key words:*** tunable Nb capacitors, electromechanical FEM simulation, intrinsic stress, white-light interferometry

Superconducting GHz electronic circuits are frequently used in radio astronomy in view of their low electrical losses and, thus, their minimal noise level. The performance of these circuits can be significantly improved by applying tunable capacitors, which can be realized as electrostatically actuated, micromechanical bridges made of superconducting niobium (Nb). To analyze the electromechanical behavior of such devices and the intrinsic stress gradient induced during the fabrication process, finite element (FE) models of the bridges and of dedicated test structures have been built. Furthermore, with a view to calibrating and validating the underlying physical model, the topography of bridges under zero voltage as well as under electrostatic actuation has been investigated by white-light interferometry. On this basis, a semianalytical model was derived, which allows a simple estimation of the pull-in voltage. Design studies based on the calibrated model have been successfully carried out to optimize devices with respect to the required specifications for their application.

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