Superconducting Planar Filter Design

Martin Baránek[1, a)], Pavol Neilinger[1, 2], Daniel Manca[1] and Miroslav Grajcar[1, 2]

[1]*Department of Experimental Physics, Comenius University, Mlynská Dolina F1, 84248 Bratislava, Slovakia*
[2] *Institute of Physics, Slovak Academy of Sciences, Dúbravská cesta 9, 84511, Bratislava, Slovakia*

[a)] Corresponding author: martin.baranek@fmph.uniba.sk

Abstract. Superconducting planar resonators of thin molybdenum carbide (MoC) films were fabricated by optical lithography. The films were deposited via reactive magnetron sputtering and by changing the deposition parameters, the sheet resistance of the films was varied. The microwave properties of the resonators were studied by broadband coplanar waveguide spectroscopy in flip-chip configuration. The kinetic inductance of MoC films governs the high frequency response of the resonators and is determined by the complex conductivity of the superconducting film. Well below the critical temperature of transition, kinetic inductance is proportional to film sheet resistance in normal state. The temperature-dependent resonances in the broadband spectra below critical temperature are described by a lumped LC model, where the inductance consists of geometric and kinetic inductance of the resonator. The temperature and frequency dependent complex conductivity of the superconducting film is calculated by the Dynes model for dirty superconductors. Furthermore, a numerical model of the kinetic planar resonator in Sonnet software is presented, which can be utilized to design resonators with desired properties, based on highly disordered superconductors. An on-chip design of a kinetic planar resonator filter is presented. The high kinetic inductance of the superconducting films allows us to minimize microwave filter dimensions.