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Fabrication of the CALDER light detectors

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The goal of the CALDER (Cryogenic wide-Area Light Detectors with Excellent Resolution) project is the development of light detectors with large active area and noise energy resolution smaller than 20 eV RMS using phonon-mediated Kinetic Inductance Detectors (KIDs). The detectors are developed to improve the background suppression in large-mass bolometric experiments such as CUORE, via the double read-out of the light and the heat released by particles interacting in the bolometers.

In this work we present the fabrication process, starting from the silicon wafer arriving to the single chip. In the first part of the project we designed and fabricated KID detectors using aluminum. Detectors are designed by means of state-of- art software for electromagnetic analysis (SONNET). The Al thin films (40 nm and 60 nm) are evaporated on high quality, high resistivity (higher than 10 kΩ*cm) Si(100) substrates using an electron beam evaporator in a HV chamber. Detectors are made in direct-write mode, using Electron Beam Lithography (EBL), positive tone resist poly-methyl methacrylate (PMMA) and lift off process.

To increase the energy resolution of our detectors we are changing the superconductor to sub-stoichiometric TiN, deposited by means of DC-magnetron reactive sputtering. For this kind of materials the fabrication method is subtractive and patterning occurs through negative tone resist Ar-n 7700 and Deep reactive Ion Etching (DRIE) process in SF 6 gas.

Finally the chip is diced into 20x20 mm 2 chip and assembled in a oxigen free copper (OFC) holder using PTFE support and measured in dilution refrigerator with base temperature of 10 mK.

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