Preliminary Investigation of MoC Thin Films for Superconducting Single-Photon Detector Applications

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Abstract. Superconducting microstrip single-photon detectors (SMSPDs) consist of a micrometer wide strip of a strongly disordered superconductor which is current biased close to the critical current [1]. Recently, single photon detection efficiency was demonstrated exceeding 90% at 1550 nm [2]. In comparison to their more developed counterparts, the superconducting nanowire single-photon detectors which are nanopatterned by electron lithography, they can be fabricated by photolithography, promisingly improving their fabrication yield, critical for large active area SMSPDs and detector arrays with high pixel counts. The detector properties are strongly determined by the material properties, such as the superconducting properties, optical properties, and their exploitability for lithography being crucial. Here, we investigate highly disordered superconducting Molybdenum carbide (MoC) films for SMSPD development. The superconducting properties of these films are widely tunable by the sputtering parameters, and its optical conductivity is strongly suppressed by quantum corrections up to the UV range [3,4]. Here, we focus on the optical properties of these films studied by spectroscopic ellipsometry and their suitability for maskless laser lithography patterning. The importance of optical absorption is twofold: it directly affects the photolithography process, and it limits the detection efficiency of the final detector. The focus is on the tuning of the optimal parameters of the lithography process with the aim of fabricating SMSPD.

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