Josephson junctions and nanoSQUIDs grown by Focused Ion Beam Induced Deposition (FIBID)

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Focused Ion Beam Induced Deposition (FIBID) is a direct-write resist-free nanolithography technique that enables the growth of high-resolution nano- and micro-structures. FIBID relies on a gas precursor that is injected into the area of interest and decomposed by a focused ion beam. Several precursors have been reported to produce superconducting deposits, as recently reviewed by us [1], among which $W(CO)_6$ is the most popular one. Using $W(CO)_6$, superconducting in-plane nanowires with 20 nm lateral resolution have been achieved [2], as well as three-dimensional superconducting helical nanowires [3]. In this contribution, we will present recent results on the fabrication of Josephson junctions and nanoSQUIDs based on FIBID-grown W-C deposits. First, results of W-C nanoSQUIDs patterned as two large pads connected by two short nanowires will be shown. In these devices, the critical current oscillates as a function of the externally-applied magnetic field, which results in a large output voltage to magnetic flux change (1.3 mV per magnetic flux quantum) [4]. Interestingly, these nanoSQUIDs can be implemented on a cantilever, which would find applications in scanning-SQUID technology. Secondly, experiments on Josephson Junctions (JJs) and nanoSQUIDs based on Bi_2Se_3 micro-crystals and W-C superconducting contacts will be discussed. The obtained results indicate the coexistence of various oscillatory responses corresponding to the individual behaviour of the JJs and to the SQUID interferences [5]. In summary, FIBID has been found to be very useful for the nanoscale direct-write fabrication of superconducting devices for application in quantum technologies [6].

References

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Figures

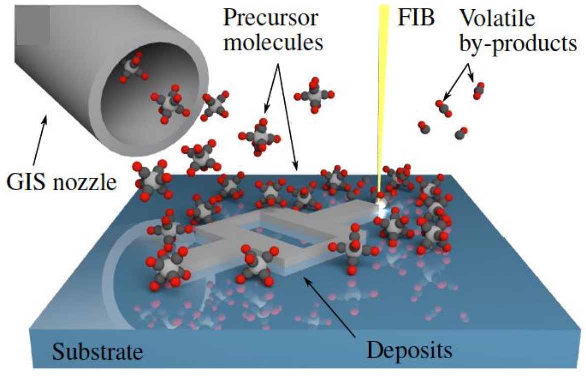

Figure 1: Sketch showing the growth of a W-C nanoSQUID by Focused Ion Beam Induced Deposition (FIBID) technique.