

Preparation and study of amorphous topological superconductors of Bi-Sb

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Superconducting materials are key elements in emerging quantum technologies, whose ultimate goal is to bring quantum physics to devices and sensors. On the other hand, the new field of Topological Insulators within Condensed Matter Physics also offers great prospects for future applications in the world of quantum computing, among others. Even more recently, two extensions of this field are awakening great interest: on the one hand, the presence of non-trivial topological properties in amorphous, i.e., non-crystalline materials; on the other hand, the possibility of preparing topological superconductors, with presumed Majorana modes, which would be a powerful basis for quantum computing.

The proposed Master Thesis experimental work focuses on actively participating in the preparation and first characterization studies of some superconducting amorphous materials that could potentially have non-trivial topological properties. Specifically, our group has set out to investigate the promising bismuth-antimony alloys, specifically in the range from pure Bi to approximately 20% doping with Sb, where the stable crystalline phase is a topological insulator. In the amorphous state, they are very interesting superconducting materials with critical temperatures around 6 K, so they are potential candidates for topological superconductivity. Although, according to the scientific literature, Bi-Sb alloys tend to crystallize unless they are at very low temperatures (for this reason no one has obtained them yet), our group has developed some hypotheses and strategies to overcome such difficulties.

The MSc student would participate in the preparation of thin films of Bi-Sb in the Microelectronics Laboratory, in the irradiation with MeV ions at CMAM to amorphize the samples in a deep region, and finally in the characterization of their electrical resistance to observe its possible superconducting transition in the Low Temperature Laboratory.

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<https://www.cmam.uam.es/> ; <https://www.fmc.uam.es/research/low-temperature-lab/>