

Electrically Characterizing NbSe₂ through Soft Micro-Stencil Lithography and Atomic Force Microscopy

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Through the years, researchers have discovered various nanomaterials that are both sensitive to chemical exposure and have extremely non-planar surfaces. Unfortunately, these unique features make such nanomaterials hard to electrically characterize since our current characterization techniques require either planar substrates or harsh chemicals. To alleviate this issue, I worked on developing a novel microfabrication procedure named Soft Micro Stencil (SMS) lithography, which employs a polymer based stencil mask that is patterned using electron beam lithography. Using SMS lithography, we can finally electrically test these nanomaterials and find potential applications for them in both research and consumer electronics. This SMS procedure provides for high resolution construction of nanodevices on both planar and non-planar surfaces of nanomaterials: a feat that expands the toolset of researchers in nanoscience. Tailoring SMS lithography to NbSe₂ (one of the new nanomaterials that has yet to be tested) provides a chemical-free procedure to fabricate nanostructures for electrical testing on the surface of a 20-30nm piece of NbSe₂ without surface contamination or other damage. This study further details the physical characterization of such nanomaterials using atomic force microscopy (AFM). Running a current through layers of NbSe₂ results in properties similar to those of graphene (a single layer of carbon in a hexagonal pattern) in terms of superconductivity thereby enabling the potential usage of NbSe₂, as well as other nanomaterials, in future electronics.