Title:	Tip-induced Superconductivity in Topological Semimetals
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Abstract:	In this thesis, we have shown the emergence of a tip-induced superconduct- ing phase (TISC) at mesoscopic junctions between a normal metal (Ag) and a topological Dirac (Cd 3 As 2) or Weyl semimetal (TaAs) or nodal semimetal (ZrSiS). The emerging interfacial superconductivity under a mesoscopic junction is unex- pected and novel because the materials forming the mesoscopic contacts are non- superconducting in nature. From theoretical considerations it is believed that the topological semimetals exist close to the topological phase boundaries and can be driven into topologically distinct phases by breaking certain symmetries. The emerg- ing TISC on the topological semimetals discussed in the thesis are most possibly due to topological phase transitions driven by the metallic point-contacts. In order to investigate the nature of the superconducting phase in such cases, we have done transport and magneto-transport based spectroscopic measurements by employing point-contact spectroscopy (PCS). PCS is an energy resolved spectroscopic measure- ment technique which involves mesoscopic contacts between two materials. PCS on superconducting materials provides useful information about the energy gap and its symmetry in the momentum space. In addition to this work on topological semimetals, we have also studied phys- ical properties of several semiconductors using different modes of scanning probe microscopy (SPM). The modes include Atomic force microscopy (AFM), Piezore- sponse force microscopy (PFM), Magnetic force microscopy (MFM) etc.. Through PFM we have shown the existence of local ferroelectric ordering in certain semicon- ducting materials like AgSbSe 2 and SnTe which also have superior thermoelectric properties. From PFM experiments on a number of non-ferroelectric systems (Sil- icon, printed circuit board etc.) we have shown that PFM cannot be used as a “smoking gun” of ferroelectricity. In this context we have shown the ferroelectric-xiv like hysteresis behavior emerging on silicon. We have also shown nano-structuring on silicon using AFM lithography.
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