Title:	Imaging, Domain Writing and Spectroscopy using Scanning Probes
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Abstract:	In this thesis work, we have standardized the different operational modes of commercial atomic force microscope(AFM) including Non-contact and Contact topography, Force Mapping, Lateral Force Microscopy (LFM), Magnetic Force Microscopy, Piezoresponse Force Microscopy (PFM), Electrostatic Force Microscopy (EFM) and Conductive AFM. Using the above mentioned experimental techniques we have shown that mechanical properties like friction and adhesion is modulated in a quasi-periodic fashion in correlation with topographic modulation in certain transparent insect wings. The natural motivation for such modulation is not understood and that might be an important open problem in biology. The surface of these wings have self-cleaning and anti-wetting properties. This work is significant in the context that it has meritorious applications in fabrication of artificial surfaces having such properties. We have used Piezoresponse Force Microscopy to show that electrically active domains can be written and erased on single crystals of SrTiO3 at remarkably high temperatures up to 440K. Observation of hysteretic phase switching indicates that SrTiO3 might have a high temperature ferroelectric phase. Since the surface of SrTiO3 is itself electrically active, its usage as a substrate and hetero-structures such as LaAlO3/SrTiO3 should be revisited. We also investigate the ferroelectric behaviour of a recently discovered thermoelectric semiconductor AgSbSe2 and we infer that it possesses nanometer scale ferroelectric domains that could potentially scatter mid-wavelength phonons and reduce thermal conductivity thereby enhancing the thermoelectric figure of merit (zT).
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