# Abstract

This thesis discusses the design and development of a technique which focuses on visualization of nanoscale structures using a regular bright-field optical microscope without the need of any additional fluorescent tags. We refer to this technique as Bright-field Nanoscopy (BFN). The mechanism involves a device which works on the phenomenon of interference producing strong thickness dependent colour response of ultra-thin films of Germanium on an optically thick Gold film. The Ge films get etched due to the dissolution of its oxide, $GeO_2$ in water. Any nanoscale object placed on the Ge device, impedes the transport of water to the Ge film resulting in a differential transverse etch rate and consequently giving rise to a local colour difference. The generated colour contrast was significant enough to be picked up by any conventional optical microscope. Using this technique, we were able to directly image grain boundaries in single layer graphene and single metal nanoparticles.

Additionally, we demonstrate the use of this technique for direct visualization of water transport through polymer nano-films. For the first time, the prominent odd-even effect known in polyelectrolyte multilayers (PEMs) was directly visualized. Further, we used this technique to directly image the nanoscale organization of the interpenetrating networks in polymer thin films. We will also discuss how this technique could also be extended to measuring ion transport across nano-membranes.