# "BNC Distinguished Seminar Series"

## Thursday, October 16th, 2014 @ 4:00pm
## MRGN, ROOM 121

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## Title: Field Assisted "Z" orientation of Nanophases to Produce Functional films using a Novel Roll to roll manufacturing platform

**Abstract:** Electric[1,2], Magnetic[3,] and Thermal gradient[5,6] fields are three important methods used in Field Assisted Self Assembly (FASA) of polymer blends, block copolymers, liquid crystals and polymer nanocomposites. These assisted assembly techniques have been used in laboratory scale, but for potential applications such as flexible electronics[7], membranes[8], supercapacitors[9], fuel cells[10], photovoltaic's etc. a large scale manufacturing platform is needed. We introduce a novel roll to roll process developed in our laboratories to achieve "Z-direction" alignment of nanostructural units. A 70 ft line was designed which uses a casting system to deposit desired thickness of liquid such as a monomer and/or polymer solution up to 6" wide on a flexible substrate using a doctor blade system and flow coating system to deposit thin films. The substrate is then carried by pretensioned steel belt through an electric field application zone which consists of a parallel electrode sitting on top of the steel belt with the solution cast film passing below it. The electric field applied can be a DC, AC or a biased AC, hence using the various fields we can maximize the orientation by increasing the dielectric contrast between the particles and the matrix. If orientation and self-assembly through magnetic field is desired, the second tool located downstream is activated. This electromagnet is capable of applying magnetic fields up to 2.2 T to the material supported by a flexible substrate through the opposing poles. This line also contains a movable UV lamp which can be used to freeze the structure of required morphology using photocurable resin and could also be used to etch one phase of a polymer blend or block copolymer after electric field or magnetic field application zones. The final tool that is built on this machine is the Thermal Alignment zone. It is designed to apply a "line of heat" oriented transverse to the line direction at 9 different zones. In each zone the material may be subjected to a temperature gradient in the machine direction through a successive heating and cooling units. The temperature gradients can be created using conduction or radiation. Electric and magnetic field alignment of particles and polymer chains is studied through real time birefringence measurement, to determine various parameters effecting the orientation of particles/phases inside a polymeric film under the magnetic or electric field. The birefringence system is based on the solution drying process developed in our lab[11].

**References:**

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