608b Ultrathin Films by Covalent Molecular Assembly: Polythiophene-Polyimide Composites with Reduced Surface Resistivity

Fengxiang Zhang and M. P. Srinivasan

Polyimides are well-known high performance materials possessing excellent mechanical strength, chemical and thermal stabilities and are employed extensively in many areas in microelectronics. However, static charge may be generated in many of these applications leading to detrimental performance. It is desirable that the PI insulating or alignment layers exhibit reduced surface resistivities so that the static charge can be dissipated.

Reduced surface resistivities of polyimide films have been achieved through inclusion of electroactive species such as carbon black/graphite and polymers such as polythiophenes, polypyrroles and polyanilines. Typically, the polyimide and the conducting species are mixed randomly or held together simply by Van der Waals force or ionic interaction, which may not insure good mechanical strength of the composite film structure. Post-processing steps may also have unfavourable effects on film conductivity.

Since covalent bonds have high bond energies (320-1000 KJ/mol), giving rise to better mechanical and thermal properties, this work investigates the preparation of covalently cross-linked polyimide composite films with reduced surface resistivities making direct use of preformed hydroxyl-functionalized polyimide and poly (thiophene-3-acetic acid). The films are fabricated by covalent molecular assembly – (layer-by-layer assembly of molecular layers with interlayer covalent bonding). The polyimide and polythiophene are linked through ester bonds between the hydroxyls in polyimide and the carboxyl groups in polythiophene, insuring mechanical, chemical and thermal robustness. Meanwhile, the imidization step that is necessary in conventional polyimide is obviated. The composite films thus fabricated display electrical conductivities suitable for antistatic applications.