A novel nanocomposite material consisting of C_{60} molecules dispersed in an insulating polymer (polyvinyl phenol or polystyrene) for memory devices is proposed. The ease of fabrication and molecular nature (the C_{60} molecules store the charge) of the devices combine the advantages of organic and molecular electronics. Our preliminary work demonstrates that the nanocomposite devices exhibit high and low conductance states, rapid switching, low power consumption, long term cycling stability and data retention which render them suitable for membership in the class of novel non-volatile, high speed memory devices. Our primary objective is to thoroughly investigate the fundamental properties of C_{60}/insulating polymer nanocomposites as organic memory materials. In addition, our research will provide insights into the deposition of metal nanowires onto polymer thin films using nanotransfer printing (nTP). Furthermore, information regarding power dissipation by the metal nanowires and impedance in crosspoint architecture organic memory devices will also be obtained. We anticipate that such fundamental knowledge will be essential for the future development of realistic organic memory devices from C_{60}/polymer nanocomposites.

Towards this end, the project has two primary technical aims. **In the first aim**, we intend to thoroughly characterize our nanocomposite materials and macroscopic devices in order to investigate and understand the charge transport, transfer and storage mechanisms. **In the second aim**, we intend to use nTP to fabricate C_{60}/polymer memory devices using the crosspoint architecture with nano-sized features in order to investigate nanoscale effects. nTP is a method developed by Bell Labs that allows 'soft' deposition of reliable conformable electrical nano-contacts over large areas. nTP is a purely additive technique so the active organic layer is not exposed to etchants, sacrificial resists and solvents.

The ***intellectual merit*** of the proposal firstly arises from its materials science impact – a realistic all organic memory device has yet to be demonstrated. Secondly, the use of C_{60} fullerene molecules as the memory element within an insulating polymer offers intriguing possibilities arising from the fact that the storage medium is brought down to molecular dimensions. This combined with the inherent ease of fabrication of organic electronics allows progress towards next generation of molecular-scale functional memory devices. Furthermore, nTP has not been investigated for fabrication of crosspoint arrays. The research will also provide knowledge regarding the chemistry of transfer and adhesion of metal contacts onto organic materials.

The ***broader impacts*** of the proposed project arise from the development of a fast switching, low power consuming and non-volatile memory which would encourage more standby operations, save energy and extend battery life. The organic memories would also provide instant boot up and faster processing. The project also involves industrial collaboration with Bell Labs, Nano Engineered Innovation Corporation and Ion Bond Inc.

Complementing the technical plan is the PI's commitment to bringing science and engineering to underrepresented minority students and women. The educational goal of this Career Development Plan has three important objectives:

- **To bring science and technology to local underrepresented minority students and girls from grades K – 12** through summer research experience for teachers (RET) and building partnerships with elementary and high schools in local communities with high population of minority students (such as Newark, NJ).
- **Recruit and mentor undergraduate minority and women students** from minority (Norfolk State University and City University of New York) and women's undergraduate colleges (Douglass College) for the NSF summer research experience for undergraduates (REU) program to carry out research on topics related to polymer devices.
- **To incorporate polymers into the undergraduate curriculum** in order to involve students in projects that emphasize interdisciplinary research, engineering and teamwork. Specifically, to develop an Organic Electronics course with a Laboratory module for engineering students.