FLEXIBLE ELECTRONICS: MATERIALS and DEVICE FABRICATION

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Abstract
This dissertation will outline solution processable materials and fabrication techniques to manufacture flexible electronic devices from them. Conductive ink formulations and inkjet printing of gold and silver on plastic substrates were examined. Line patterning and mask printing methods were also investigated as a means of selective metal deposition on various flexible substrate materials. These solution-based manufacturing methods provided deposition of silver, gold and copper with a controlled spatial resolution and a very high electrical conductivity. All of these procedures not only reduce fabrication cost but also eliminate the time-consuming production steps to make basic electronic circuit components. Solution processable semiconductor materials and their composite films were also studied in this research. Electrically conductive, ductile, thermally and mechanically stable composite films of polyaniline and sulfonated poly (arylene ether sulfone) were introduced. A simple chemical route was followed to prepare composite films. The electrical conductivity of the films was controlled by changing the weight percent of conductive filler. Temperature dependent DC conductivity studies showed that the Mott three dimensional hopping mechanism can be used to explain the conduction mechanism in composite films. A molecular interaction between polyaniline and sulfonated poly (arylene ether sulfone) has been proven by Fourier Transform Infrared Spectroscopy and thermogravimetric analysis. Inkjet printing and line patterning methods also have been used to fabricate polymer resistors and field effect transistors on flexible substrates from poly-3-4-ethyleneoxythiophene/poly-4-sytrensulfonate. Ethylene glycol treatment enhanced the conductivity of line patterned and inkjet printed polymer thin films about 900 and 350 times, respectively. Polymer field effect transistors showed the characteristics of traditional p-type transistors. Inkjet printing technology provided the transfer of semiconductor polymer on to flexible substrates including paper, with high resolution in just seconds.

Flexible Electronics: Materials and Applications surveys the materials systems and processes that are used to fabricate devices that can be employed in a

wide variety of applications, including flexible flat-panel displays, medical image sensors, photovoltaics, and electronic paper. Materials discussed range from polymeric semiconductors to nanotube transparent conductors, and the important characteristics of each system and their target applications are highlighted. An overview of the performance benchmarks for the different materials is given in order to allow a direct comparison of these di... Introduction. Previous Work. Properties of Transistor Materials. Device Structures. Fabrication on Flexible Substrates. Flexible TMO Device Results.