Semiconducting Fibers Through Electrospinning for Flexible Electronics Using Organic Polymers

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Flexible electronics are an increasingly important field due to the growing demand for lightweight, bendable, and low-cost devices that can conform to nontraditional surfaces. Applications such as foldable displays, wearable health monitors, and smart textiles require materials that can withstand stretching and twisting without losing functionality. Conventional inorganic semiconductors, such as silicon, are mechanically rigid, limiting their use in flexible systems. This project investigates a conjugated polymer, poly(3-hexylthiophene) (P3HT), and a flexible polymer, polyethylene oxide (PEO), as an alternative material system for flexible electronic applications. Blended P3HT/PEO solutions were processed using electrospinning, a technique that applies a strong electric field to draw charged polymer solutions into continuous fibers with high surface-area-to-volume ratios. The resulting fibers had average diameters of approximately 1-3 micrometers and exhibited mostly uniform, bead-free morphology facilitated by the ease of processability of PEO. P3HT provided semiconducting pathways necessary for charge transport. The self-assembly behavior of P3HT chains over time was captured by visual observation. With time, the P3HT chains self-assembled, leading to very high viscosity and a distinct color change. Electrical conductivity of the fibers was evaluated using a circuit-based measurement setup to record current–voltage. These results demonstrate that the electrospun P3HT/PEO fibers exhibit measurable conductivity and structural stability, supporting their potential use in flexible and wearable electronic devices.

Awards Won:

Midwest Microelectronics Consortium: Four cash awards of $3,000 each.