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Research Area: Creating Smart Textiles from Polyelectrolyte Multilayers

Abstract:

Nanotechnology has brought the promise of delivering sophisticated electronic devices in compact packaging, made of many new materials such as quantum dots, carbon nanotubes and other conducting organics on a range of new substrates, including flexible materials such as plastics or textiles. The general **research area of this proposal is to work on "smart" textiles** which can be used to incorporate functionality into uniforms. These functionalities include actuation, sensing and health monitoring, protection to environmental stimuli, and power storage. The work will focus on electrically conducting films and simple electrochemical cells on various types of textiles, which are the building blocks needed for any of the above mentioned functionalities. One method to integrate electronic functionalities into textiles is to weave metal or conducting polymer yarns into the fabric itself. This has some limitations in that it can be very expensive, but more important significantly decreases the flexibility and comfort of these materials. Instead of weaving metallic or other types of conducting fibers into fabrics, the PI proposes to modify existing textiles with polymer coatings using a combination of the layer-by-layer (LbL) technique for assembling polyelectrolyte multilayers (PEMs) and vapor deposition techniques. PEMs are polymer blends, so it is possible to incorporate multiple functionalities important for smart clothing. The PI will target not only electrical conductivity but oxygen and water transport as well, for the comfort of the wearer. The PI is working in cooperation with Svaya Nanotechnologies to use a spray deposition system for the LbL coating process. This spray deposition technique has been shown to be able to tailor coating morphologies of electrospun mats in such a way to either individually coat fibers or create a film across the top of the mat. Use of the LbL method will allow for coatings on traditional or nonwoven textiles. This technology could potentially lower manufacture costs as compared to that of special textiles and be more versatile in the types of materials that may be used. Another area of investigation will be on chemical stability of these films, in environments similar to being washed. One can imagine that such textiles might have use for military uniforms, astronaut uniforms, or monitoring the health of elderly and infirm patients.

The educational activities proposed by the PI include recruiting of high school students to increase underrepresented groups in the undergraduate mechanical engineering program (especially female students), and increasing awareness of materials science. The PI has been and will continue to teach introduction to materials science, and has been developing a set of demonstrations in the class that can be used to teach high school students.