MECHANICAL ENGINEERING SEMINAR

Wednesday, May 14 2025 at 13:30, D. Dan and Betty Kahn Building, Room 217

"Mix-and-Match" - Electrospinning of Complex Nanofibers for Chem/Med/Bio Applications

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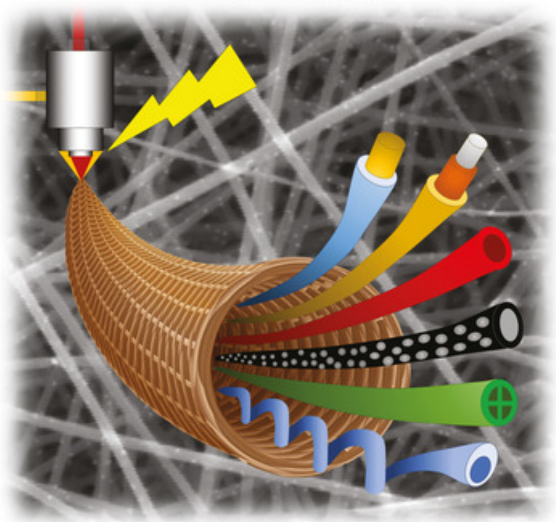
Hosted by: Prof. Eyal Zussman

An important direction in novel materials research is the formation of complex fibers with desired properties brought about using composite materials and specific structures and morphologies. Complex polymer fiber formation using the electrospinning method is a surprisingly versatile method that has enabled the production of a large variety of materials with extremely high surface to volume ratio. In electrospinning, an electric field is used to extract a fluid jet from a nozzle connected to the source of the fluid. As the charged jet spins under the influence of the electric field the liquid solvent evaporates, and a continuous solid fiber is deposited on a collecting substrate electrode.



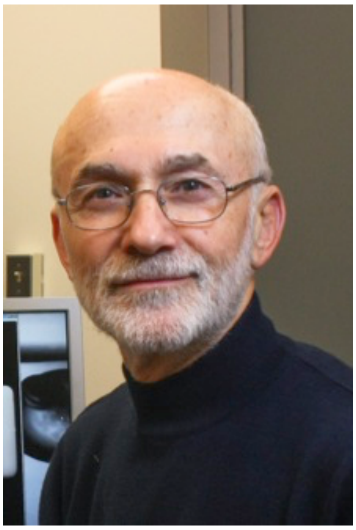
The past decade has witnessed an explosive growth in electrospinning activity, as indicated by the number of publications and patent applications. This is testimony to the attractive features of the electrospinning fiber membrane formation process: ability to use many polymers, relatively low cost of entry, versatility in being able to target many applications. This includes applications in important fields, including biomedical/health care, textiles, environment, energy, agriculture, sensors/electronics.

An extremely important version of this technique utilizes electrospinning through a coaxial nozzle to form core-sheath fibers that incorporate a combination of materials. In this overview presentation, we first introduce electrospinning basics and then review recent developments and applications, with special emphasis on coaxial electrospinning forming multilayer fibers with a core-sheath structure. By forming a fiber that consists of *complementary* materials in the core and the sheath, one can design complex materials with a set of properties that are not available in uniform fibers made of a single material. Several key applications of core-sheath fibers are discussed, including superhydrophobic membranes, stimuli-responsive fibers, membranes providing controlled release of functional molecules for chem/bio/medical applications (anti-toxin enzymes, antibacterial agents, drug release, etc.). The presentation concludes with a look ahead at the future promise and challenges of coaxial electrospinning polymer fibers.[1]

[1] D. Han and A. J. Steckl, ChemPlusChem, Oct 2019 https://doi.org/10.1002/cplu.201900281

Seminars Coordinator: Assoc. Prof. Shmuel Gal.

Andrew Steckl is Ohio Eminent Scholar, Gieringer Professor and Distinguished University Research Professor at the University of Cincinnati in the Department of Electrical and Computer Engineering and is also affiliated with the Materials Science and Engineering Program and the Biomedical Engineering Department. Dr. Steckl obtained his BS degree from Princeton University and his MS and PhD degrees from University of Rochester. He is a Life Fellow of the Institute of Electrical and Electronic Engineering (IEEE), Fellow of the National Academy of Inventors, and Fellow of American Association for the Advancement of Science (AAAS) "For Distinguished Contributions to Optoelectronics". In 2022, he was recognized by the Electrochemical Society with the Electronics & Photonics Award.



After several years in industrial R&D, Dr. Steckl joined Rensselaer Polytechnic Institute in 1976 as a faculty member in the Electrical & Computer Engineering Department, where he founded the Center for Integrated Electronics, a multi-disciplinary campus-wide activity. At the University of Cincinnati since 1988, Dr. Steckl's current research activities are in: point-of-use biosensors; electrospinning of complex nanofibers and related membrane chem/bio/med applications. To date, Prof. Steckl has graduated 50+ Ph. D. students and has supervised 13 post-doctoral fellows. Together with his students, he has published ~ 450 papers, which have received ~ 18,000 citations to date. This has resulted in a current citation *h-index* of 72. Prof. Steckl has also obtained 26 patents on various electronic & biomedical materials and devices.