ABSTRACT

Hierarchical Assimilation of Electrospinning and 3D/4D Printing for Producing Smart Materials and Devices

Ashok Vaseashta Prof. Dr. Acad.

CEO/CTO, International Clean Water Institute, VA, USA
Academician: Euro Mediterranean Academy of Arts and Sciences.
Professor, Transylvania University of Brasov, Brasov, ROMANIA
IEEN Chaired Professor of Nanotechnology, Academy of Sciences of Moldova, Chisinau, MOLDOVA

Electrospinning is an effective and versatile technique used to produce porous structures ranging from submicron to nanometer diameters. Using a variety of high-performance polymers and blends, several porous structure configurations have become possible for applications in tactile sensing, energy harvesting, filtration, and biomedical applications, however, the structures lack mechanical complexity, conformity, and desired three-dimensional single/multi-material constructs necessary to mimic desired structures. A simple, yet versatile, strategy is through employing digitally-controlled fabrication of shape-morphing by combining two promising technologies, viz., electrospinning and 3D printing/additive manufacturing process. Using a hierarchical combination of suitable configurations, elaborate shapes, and patterns are printed on mesostructured stimuli-responsive electrospun membranes, modulating in-plane and interlayer internal stresses induced by swelling/shrinkage mismatch, and thus guiding morphing behaviors of electrospun membranes to adapt to changes of the environment. Recent progress in 3D/4D printing/additive manufacturing processes includes materials and scaffold constructs for tactile and wearable sensors, filtration structures, sensors for structural health monitoring, biomedical scaffolds, tissue engineering, and optical patterning, among many other applications to support the vision of synthetically prepared material systems that mimic many of the structural aspects with digital precision. A novel technology called 3D jet writing was recently reported that catapults electrospinning to adaptive technologies for the manufacturing of scaffolds

according to user-defined specifications of the shape and size of both the pores and the overall geometric footprint. This presentation provides an overview of the hierarchical synergy between electrospinning and 3D printing as a methodology for preparing smart materials and devices that are likely to evolve next-generation structures into reality.

Keywords: electrospinning, 3D printing, 4D printing, prototyping, jet printing