Capitol Graduate Research Summit

Sustainable Freshwater Harvesting from Atmosphere through Electrospun Superhydrophobic Polyacrylonitrile Nanocomposite Fibers

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The scarcity of pure drinking water has been one of the major humanitarian challenges in the globe. The world population growth, urbanization, depleting water resources and global climate change have intensified this crisis especially in arid and semi-arid regions. The concern is drastically increasing and therefore scientists and engineers are challenged with urgently developing viable solutions for this problem. The development of a sustainable, cost-effective, reliable and efficient water collection materials and methods for continuous freshwater production is crucial for many regions of the world. In this work, polyacrylonitrile (PAN) and Poly (methyl methacrylate) (PMMA) with various proportions of titanium dioxide (TiO_2) nanoparticles and aluminum (Al) microparticles were spun into superhydrophobic nanocomposite fibers using electrospinning technique followed by stabilization and carbonization to remove all non-carbonaceous material from the fibers and use for harvesting fog from the atmosphere. The fiber morphology, surface hydrophobicity and fog harvesting capacity of the nanocomposite fibers were investigated. Test results reveal that the carbonized nanocomposite fibers exhibit superhydrophobic characteristics with a water contact angle of 154.8° with efficient fog harvesting ability of 621 mg/cm^2-hr. The nanotechnology-based water collection systems are unique because of the multifunctional properties of the nano-membranes. Kansas is in short supply of freshwater and this technology will help sustainable economic growth in the region. The produced water can be used for drinking, agriculture, gardening, medical, industrial, and other purposes.