Functional Hybrids and Nanocomposites as Sustainable Materials for Environmental Solutions

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In the time of global environmental concerns, material development and utilization must involve sustainability aspects. At the National Nanotechnology Center (NANOTEC), National Science and Technology Development Agency (NSTDA), our research group explore the potential of functional nanomaterials and materials processing in improving functional hybrids and nanocomposites as sustainable materials for the environmental solutions. In the pursuit of functionality, scalability and cost-effectiveness, our research group challenges surface modifications and nano-dispersion of nano-functional materials technology, processing and assemblies of hybrids membrane, thin-film and fibers. We aim to develop the integrated nano-materials and engineering systems technology for applications in energy, water and air quality towards broad industrial and social applications. Among our current work, the theme of nanofunctional fibers and textiles generally spans across the whole value chain of textile industries. Our research team hopes to create and bring values to the upstream by incorporating nanomaterials into fibers for multifunctionalities. We are also driving downstream by developing multifunctional nanocoating for various types of fabrics. Multifunctional nanofiber research is our newly emerging field of scientific and industrial interest for advanced applications in biomedical textiles such as nanofiltration, tissue engineering and drug delivery. Furthermore, we aim at introducing some of these novel materials, process and functions to the real word via smart and wearable electronics. In additional, our focused theme on nanocoating strives for excellence in developing in nanomaterial and coating technologies that can be used in advanced solar energy research and applied to existing industrial products. We also aim to drive innovative research on sustainable solar energy especially organic/hybrid photovoltaic and solar concentrator using our core technologies developed at NANOTEC. In addition, we focus on integrating nanotechnology such as low-cost and multifunction coating to domestic industrial products especially in building and apparel material. Another endeavor on clean water focuses on research development of hybrid nanomaterials for environmental applications and clean water. We emphasize the combination of material functionalities, employing knowledge and skills in organic/inorganic chemistry, material science, and biological science. The advanced synergy in our group is gained from various expertise demonstrated by means of synthesis, fabrication, characterization and experimental designs in lab test, and field test. For the industrial impact, we focus on an innovative design and process of hybridization of polymers and nanomaterials with novel features and structures at a nanoscale. The designed nanocomposite materials have unique properties in film, powder, gel and solution which are used for industries. Our strategy is to precisely control the functional properties of nanocomposite materials either within the matrix or on the surface of these materials. We aim to develop these new materials for a manufacture scale at low cost with simple processing technology, all of which towards the ultimate goal of social and economic impact.

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Education

- 2002 B.S. Chemistry, University of Wisconsin-Madison, Wisconsin, USA
- 2007 Ph.D. Polymer Science and Engineering, University of Massachusetts-Amherst, Massachusetts, USA

Research Interest

- Nanofibers and nanofibrous membranes for nanofiltrations
- Multifilament and nonwoven melt-spinning
- Nanocoating for functional yarns and fabrics
- Grinding and nanodispersion
- Polymeric hybrids and nanocomposite

Selected Publications

- Narkbuakaew, T. and **Intasanta, V.*** Modified g-C3N4 with boron doping for efficient simultaneous catalytic reduction of Ag+ and organic pollutants. Materials Today Sustainability 2022, 20, 100258. DOI:10.1016/j.mtsust.2022.100258
- Panith, P., Butnoi, P. and **Intasanta, V.*** The Hybrid Structure of Nanoflower-Like CoxMnyNizO4 Nanoparticles Embedded Biomass-Lignin Carbon Nanofibers as Free-Standing and Binder-Free Electrodes for High Performance Supercapacitors. Journal of Alloys and Compounds 2022, 918 (21),165659. DOI:10.1016/j.jallcom.2022.165659
- Butnoi, P., Pangon, A., Berger, R., Butt, H. and **Intasanta, V.*** Electrospun nanocomposite fibers from lignin and iron oxide as supercapacitor material. Journal of Materials Research and Technology 2021, 12, 2153. DOI:10.1016/j.jmrt.2021.04.017
- Saikaew, R. and **Intasanta, V.*** Versatile Nanofibrous Filters against Fine Particulates and Bioaerosols containing Tuberculosis and Virus: Multifunctions and Scalable Processing. Separation and Purification Technology 2021, 275, 119171. DOI:10.1016/j.seppur.2021.119171
- Suntamit, B., Vanichvattanadecha, C. and **Intasanta, V.*** Effect of ZnO Nanoparticles on Hydrophobicity, Biological and Mechanical Properties of Side-by-Side Bicomponent PP Fibers. Fibers and Polymers 2021, 22, 1607. DOI:10.1007/s12221-021-0229-1

- Chawengkijwanich, C., Pokhum, C., Srisitthiratkul, C., Subjalearndee, N., Pongsorrarith, V., Yaipimai, W., Phanomkate, N., and **Intasanta, V.*** Fabrication of Water-Based TiO 2 -Coated Pleated Synthetic Fiber toward Photocatalytic Oxidation of VOCs and CO for Indoor Air Quality Improvement. Journal of Environmental Engineering 2019, 145 (6). DOI:10.1061/(ASCE)EE.1943-7870.0001521
- Subjalearndee, N. and **Intasanta, V.*** Structural Development of Nanosilver on Metal Oxide Nanofibrous Membrane by Plasma Enhanced Chemical Vapor Deposition (PECVD). Applied Surface Science, 2018, 452, 306-313. DOI:10.1016/j.apsusc.2018.04.215
- Subjalearndee, N. and **Intasanta, V.*** Mechanically robust, multifunctional and ultrathin nanomembranes for tuberculosis elimination. RSC Advances, 2017, 7, 46906-46915. DOI:10.1039/C7RA08762D
- Subjalearndee, N., Phanomkate, N., and **Intasanta, V.*** A novel and practical process to sustainable mosquito-borne disease prevention. Fibers and Polymers, 2017, 18, 2235-2247. DOI:10.1007/s12221-017-6812-9
- Woranuch, S., Pangon, A., Puagsuntia, K., Subjalearndee, N., and **Intasanta, V.*** Starch-based and multi-purpose nanofibrous membrane for high efficiency nanofiltration. RSC Advances, 2017, 7, 35368–35375. DOI:10.1039/C7RA07484K
- Woranuch, S., Pangon, A., Puagsuntia, K., Subjalearndee, N., and **Intasanta, V.*** Rice flour-based nanostructures via a water-based system: transformation from powder to electrospun nanofibers under hydrogen-bonding induced viscosity, crystallinity and improved mechanical property. RSC Advances, 2017, 7, 19960-19966. DOI:10.1039/C7RA01485F
- Subjalearndee, N. and **Intasanta, V.*** Thermal relaxation in combination with fiberglass confined interpenetrating networks: a key calcination process for as-desired free standing metal oxide nanofibrous membranes. RSC Advances, 2016, 6, 86798–86807. DOI:10.1039/C6RA15086A
- Yaipimai, W., Subjalearndee, N., Tumcharern, G., and **Intasanta, V.*** Multifunctional metal and metal oxide hybrid nanomaterials for solar light photocatalyst and antibacterial applications. Journal of Materials Science, 2015, 23, 7681–7697. DOI:10.1007/s10853-015-9333-1
- Yaipimai, W. and **Intasanta, V.*** Transforming Self-Agglomerated Spherical Shaped Nanostructures Into Readily Dispersable Ultrafine Nanofibers—A Model Study with Titanium Dioxide Nanoparticles. Advanced Science Engineering and Medicine 2014, 6 (7). DOI:10.1166/asem.2014.1515
- Yaipimai, W. and **Intasanta, V.*** Fabrication of Multifunctional Nanofibers Against Broadspectrum Biochemical Hazard. Science of Advanced Materials 2014, 6, 448. DOI:10.1166/sam.2014.1737
- Srisitthiratkul, C., Yaipimai, W. and **Intasanta, V.*** Applied Surface Science 2012, 259, 349. DOI:10.1016/j.apsusc.2012.07.050
- Srisitthiratkul, C., Pongsorrarith, V. and **Intasanta, V.*** Green Syntheses of Visible Light Active Ultrafine Photocatalyst Nanofibers by Solution-Based Electrospinning. Advanced Science Engineering and Medicine 2012, 4, 299. DOI:10.1166/asem.2012.1171

- Srisitthiratkul, C., Pongsorrarith, V. and **Intasanta, V.*** Structure and Environmental Remediation of Visible and Ultraviolet Light Active Tungsten-Titanium Oxide Electrospun Nanofibers. Advanced Science Engineering and Medicine 2012, 4, 288. DOI:10.1166/asem.2012.1170

Selected Patens

- **Intasanta, V.** and Subjalearndee, N. Stable, as-designed metal oxide nanofibers and flexible and stable nanofibrous membrane thereof with fabrication process of fiber and nanofibrous membrane thereof. Patent Cooperation Treaty (PCT) application
- **Intasanta, V.** and Subjalearndee, N. Multifunctional nanofibrous filter for water and air microfiltration which able to clean and resistant to sunlight with fabrication process of nanofibrous filter thereof. Patent Cooperation Treaty (PCT) application