SPEAKER

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BIOGRAPHY
Prof. Martin Thuo is a faculty in the Department of materials science and engineering, with secondary appointment in electrical & computer engineering, at Iowa State University. He received a Ph.D. from University of Iowa followed by a Mary-Fieser post-doctoral fellowship (2009-2011) then served as a Nanoscale Science & Engineering Center Fellow (2011-2013) at Harvard University under the tutelage of Prof. George M. Whitesides. He is the recipient of several awards such as the Lynn-Anderson research excellence award, MSE research excellence award, Black & Veatch faculty fellowship, among others. His research interests encompass the general theme of frugal innovation, through simplicity, with a focus on soft materials and matter transport.

LECTURE

Surface asymmetry-driven functional materials synthesis from Cellulosic fibers

Felicitous choice of surface functionalization of polymeric fibrous materials installs asymmetry in both chemical potential and mechanical properties across the fibers. We demonstrated that by using multivalent monomers, alkyl trichlorosilanes, that can react with surface adsorbed water (a bivalent reactant), the coefficient of branching, αc, is <0.5 leading to gel formation. Exploiting reaction kinetics allows for particle formation on paper fibers to create stochastically distributed hydrophobic articles leading to amphiphobic surfaces. The amphiphobicity combined with compressibility and aspect ratio of the fibers lead to designed anti-jamming colloidal lubricants. Besides asymmetry in wetting between the bulk and surface, chemical grafting of a higher flash point component on the surface should retard thermal degradation. Surface modification, therefore, alters ignition temperatures and propagation of any ignition event. Infusion of the fibers with appropriate precursors creates internal heat sinks that further interfere with thermal degradation with concomitant formation of interface-driven mixed bandgap materials. We exploit this asymmetry in thermal properties to invert the thermal degradation properties of paper fibers leading to synthesis of doped or undoped carbon microtubes for catalysis or energy storage.