3D and 4D Printing of High-Performance Polymers and Nanocomposites

ABSTRACT
Polymer nanocomposites are inspired materials that enable high-performance properties leading to new applications even under extreme conditions. 3D printing to create objects from polymeric nanocomposite materials has appended the design functionality of polymeric materials enabling wide uses and rapid scale development in new applications. Polymers can be classified into thermoplastics, thermosets, and elastomers based on their thermo-mechanical properties. Each class of polymers, when paired with a corresponding nanomaterial, can become a class of its own. This is also more evident with the choices of 3D printing methodologies (FDM, SLA, SLS, VSP), which can use blended or formulated compositions. Incorporating nanomaterials with 3D printing allows the design of new and toughened materials and applications based on nanostructuring and integrating the conversion chemistry with the printing mode. In this talk, we demonstrate the fabrication of higher performance and toughened 3D printed materials based on nanomaterials (nano clay, nanocellulose, graphene, etc.) and their nanostructuring. SLA, SLS, FDM for 3D printing towards high strength properties and their applications will be discussed. Stimuli-responsive properties are demonstrated as 4D printing examples where shape-memory and controlled wetting behavior have been observed.

BIOGRAPHY
Rigoberto Advincula is Governor’s Chair at the University of Tennessee and Oak Ridge National Laboratory (ORNL). He is also a research professor at Case Western Reserve University. He is a fellow of the American Chemical Society (ACS), a fellow of the Polymer Science and Engineering Division (ACS), fellow of the Polymer Chemistry Division (ACS). He received the distinguished Herman Mark Scholar Award in 2013. In 2018, he was elected National Academy of Science and Technology (NAST), Philippines. He recently has been appointed to the World Economic Forum, Advanced Materials Council. He is the editor of MRS Communications and Reactive and Functional Polymers. He has held several visiting professor positions, including Waseda University in Japan. His group researches polymer materials, nanocomposites, colloidal science, 3D printing, hybrid materials, and ultrathin films towards applications from smart coatings to biomedical devices. He is passionate about mentoring students and helping other countries in their STEM programs.