BIOGRAPHICAL SKETCH

Koteswara Rao Medidhi was born in Mylavaram, Andhra Pradesh, India, on August 21, 1991. He received his Bachelor's degree in Chemical Engineering from Gayatri Vidhya Parishad College of Engineering, Vizag, India in May of 2013. He entered graduate school at Tennessee Technological University, Cookeville, Tennessee, in August 2014 and worked on several projects. During his Doctorate's program he was elected as the Secretary and President for CEGRA (Chemical Engineering Graduate Research Association) twice from January 2016 to January 2019. He also had the opportunity to take up the roles of teaching and research assistants. He had presented his research work at various international conferences like APS (American Physics Society) and AIChE (American Institute of Chemical Engineers) Annual meetings. He has published 3 peer reviewed research papers and working on 4th. He also received the Carnegie foundation fellowship from Tennessee Tech for the Spring 2020 semester. His research interests are Molecular Dynamics modeling of material science and Transport properties in the flow.

EDUCATION

Ph.D. Engineering
Tennessee Technological University, 2014-2020(Expected)

B.Tech. Chemical Engineering
Gayatri Vidhya Parishad College of Engineering,
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College of Engineering, Office of Research, Department of Chemical Engineering, Center for Manufacturing and Research, Center for Energy Systems Research, Carnegie Foundation

College of Engineering

TENNESSEE TECH

The Department of

Chemical Engineering

Announces the Dissertation Defense

of

Koteswara Rao Medidhi

In Partial Fulfillment of the Requirements

For the degree of

Doctor of Philosophy in Engineering

April 1, 2020

10:30 AM

Held in

Prescott Hall 203

Tennessee Tech University

Zoom Link: https://tntech.zoom.us/j/461356965

FIELD OF STUDY

Chemical Engineering

DISSERTATION TOPIC

Structural and Thermo-Mechanical Properties of Polymer Nanocomposites

EXAMINING COMMITTEE

Dr. Venkat Padmanabhan (Chairperson)

Dr. Pedro Arce

Dr. Joseph Biernacki

Dr. Holly Stretz

Dr. Derek Cashman

ABSTRACT

Polymer nanocomposites (PNCs), formed by adding nanoparticles to a pure polymer melt, can have significant enhancement in properties such as thermal, mechanical, electrical, optical, etc., compared to that of the pure polymer. The observed improvement in the properties is not only due to the addition of nanoparticles themselves but also due to the role of the interface between the polymer chains and the nanoparticles. The dispersion of nanoparticles in polymers, which results in the enhancement of thermo-mechanical properties is dictated by intricate balance between the entropic forces, which are associated with particle geometry and size, and enthalpic forces. This research focuses on understanding the role of different types of nanoparticles including bare nanoparticles, polymer grafted nanoparticles, and polyelectrolyte grafted nanoparticles in polymers and solvents on the thermo-mechanical and flow properties of PNCs. The thermodynamic and temporal stabilities of interface and their effects on the macroscopic properties as a function of particle size distribution, interactions between polymers and nanoparticles will be studied using molecular dynamics simulation. Adding polymer-grafted nanoparticles to the polymer matrix does show enhancement in properties, but entanglements in the system leads to reduction in the mobility of nanoparticles. To improve the mobility and strength of material simultaneously, we considered polyelectrolyte grafted nanoparticles (PENPs) in solution. PENPs are quite complex as the electrostatic interactions control the solubility and network formation of grafted chains. Strong polyelectrolytes, at high pH, will allow chains to stretch because of electrostatic repulsions regardless of grafting density. At intermediate pH, the hydrogen bonding between the ionized and non-ionized groups plays a significant role in dictating the structural and flow properties of nanoparticles in the solution.