University of Southern California

USC

Sonny Astani

Department of Civil and Environmental Engineering

USC Viterbi

School of Engineering

Seminar Presentation by

Dr. Ange-Therese Akono

Department of Civil and Environmental Engineering

Northwestern University

Monday, October 5, 2020

4:00-5:00 PM

Join Zoom Meeting: https://usc.zoom.us/j/98766114432

Meeting ID #987 66114432

Passcode: 175729

Inorganic-Organic Nanomaterial Composites for Advanced Civil, Energy, and Biomedical Application

Abstract:

In recent years, there has been a strong interest in nanomaterial composites as a means to integrate multifunctional behavior with enhanced mechanical response. In civil engineering for instance, cement nanocomposites are considered in strain-sensing, damage-sensing, and structural health monitoring applications. Cement nanocomposites have also been considered for electromagnetic shielding purposes, enhanced energy recovery, and passive energy storage schemes. In this talk, I will present fundamental studies of the influence of nanoparticles and carbon-based nanomaterials on the nanoscale structure and chemistry of cement nanocomposites. To this end, I will use depth-based probing, such as nano-indentation testing or scratch testing, combined with advanced data science methods such as statistical deconvolution techniques. I will show that nanomaterials have the potential to density the structure of cement nanocomposites at the nanoscale and microscopic length-scale, leading to an enhancement in the elastic, strength, and fracture characteristics.

Despite the appeal of cement nanocomposites, a drawback of cement-based product is the large carbon-footprint and high density of cement products. Thus, there has been an increased interest in lightweight and environment-friendly cement alternatives that are synthesized using green chemistry routes. I will introduce geopolymer composites, that are inorganic X-ray amorphous polymers with a carbon footprint equal to one-fifth that of cement, and a density equal to two-thirds that of cement. By integrating carbon-based nanomaterials with geopolymer matrices, I will yield inorganic-organic composites with enhanced toughness and strength-to-weight ratio. A specific application of these novel inorganic-organic composites is bone scaffolds for bone regeneration. I will show preliminary results in my research group that supports the feasibility of geopolymer nanocomposites to promote bone regeneration in bone repair applications. Thus, I will show how, in my research group, we integrate nanotechnology, nanomaterials science, and nanoscale mechanics to address a wide range of societal issues ranging from self-sensing concrete to green concrete, and advanced bone scaffolds.

Biography:

Ange-Therese Akono completed her Ph.D. at the age of 25 years old from the Massachusetts Institute of Technology. Dr. Akono's honors include the NIH Diversity Supplement grant (2020), the NSF GOALI award (2019), the ASCE New Faces of Civil Engineering Professionals Award (2016), and the MIT Energy Initiative Fellowship (2009). Dr. Akono is an Assistant Professor in the Department of Civil and Environmental Engineering at Northwestern University. Dr. Akono's laboratory investigates multiscale fracture mechanisms in complex materials systems. This research hinges on three main thrusts: natural and nano-engineered biomaterials, geological materials, and environment-friendly and high-performance structural materials. In turn, through the support of the NSF, NIH, US DoE, and industrial partners, this multi-disciplinary research has resulted in more than 30 peer-reviewed papers in reputed scientific journals.