ESE PHD DEFENSE

The Bredesen Center for Interdisciplinary Research and Graduate Education

Monday April 3, 2023

11:00 AM – 1 PM ~ Ferris 414E

Zoom link: https://tennessee.zoom.us/j/98966713827

" Development and Characterization of Stable Low-cost Salt Hydrate-based Phase Change Materials for Thermal Energy Storage Applications"

Speaker: Mr. Damilola Akamo

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Abstract:

Renewable energy utilization is spurring interest in energy storage systems. A notable storage solution is the thermal energy storage (TES) in which thermal energy are stored and released for later use. TES systems are utilized in building systems, space heating and cooling, and refrigeration. Owing to their inexpensive cost, high energy density, and near ambient phase transition temperature, inorganic salt hydrate PCMs are garnering interest. Salt hydrate PCMs' phase separation, low thermal conductivity, and thermal cycling instability limit their long-term energy storage reliability. This study investigated the various stabilization approaches for salt hydrate PCMs extensively. Additives were used to synthesize, characterize, and improve salt hydrate PCMs at minimal cost. Throughout several heat cycles, dextran sulfate sodium (DSS) polyelectrolyte stabilized sodium sulfate decahydrate (SSD) better than other additives. Stabilization mechanism was explained using atomistic simulation. Electrostatic interactions between SSD and DSS keeps the salt hydrates in domains that prevent phase separation. Strontium chloride hexahydrate, graphene nanoplatelets (GNP), and cellulose nanofibers (CNF) were used to improve calcium chloride hexahydrate PCM. Due to CNF's amphiphilicity, it disperses GNP into a compact PCM composite with improved thermal conductivity and thermal cycle stability. For near-ambient TES applications, this work synthesized and developed salt hydrate-based eutectic PCMs with excellent heat storage and phase transition temperature. Overall, this study reveals that polyelectrolytes, bio-based nanocellulose, and eutectic methods may improve salt hydrate PCM thermal energy storage.

Biography:

Damilola Akamo was born in Lagos, Nigeria. He pursued and earned a B.S. in Mechanical Engineering from Obafemi Awolowo University, Ile Ife Nigeria, and a M.S. in Material Science and Engineering from the University of Tennessee, Knoxville (UTK). His research interests focus on the understanding of the processing-structure-property-performance relationships of materials relevant to the generation, conversion, and storage of renewable energy. He currently conducts his research at the Building Technologies Research and Integration Center, Oak Ridge National Laboratory to develop stable, low-cost, high thermal conductivity phase change materials (PCMs) for thermal energy storage applications. He was awarded the UTK Chancellor's citation for extraordinary professional promise in 2020.