Clarkson University
Department of Chemical and Biomolecular Engineering
Seminar

"Organoclay Impact on Self-Healing of Polyurethane-Urea Composite Coatings for Underwater Applications"

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Abstract

This research investigates the effectiveness of integrating amine-functionalized montmorillonite organoclay particles into polydimethylsiloxane (PDMS) and poly(ethylene glycol) (PEG)-based polyurethane-urea coatings to enhance the strength and underwater self-healing properties. The role of disulfide functional groups on the coating's mechanical properties was also studied. The physicochemical properties of the copolymer were examined using spectroscopic, diffraction, thermomechanical, and contact angle goniometry techniques. The results showed successful dispersion of clay particles within the elastomer matrix, with the amphiphilicity of these elastomers boosting their dispersion. The thermal stability of the nanocomposites improved significantly, especially for nanocomposites containing disulfide functional groups. The introduction of organoclay in the neat polyurethane-urea elastomer resulted in composites with dynamic mechanical storage modulus values of ~100 MPa. The clay particles improved the crack healing efficacy, especially underwater. Both disulfide-free and disulfide-containing elastomers showed remarkable healing capabilities in air and underwater, with a modulus of toughness recovery of almost 100% at room temperature. The organoclay-reinforced elastomers showed a toughness recovery exceeding 90% within 24 hours of underwater healing at 60°C. These results highlight the crucial functions of organoclay-reinforced polyurethane-urea elastomer coatings for underwater industrial applications like anti-biofouling coatings, membranes, and sealants.

Wednesday, 4/10/2024 at 2:30 pm
CAMP 194

Maryam Bonyani is a PhD student in the Chemical and Biomolecular Engineering Department at Clarkson University, where she is advised by Dr. Sitaraman Krishnan. Enhancing the mechanical and self-healing properties of polyurethane-urea elastomer coatings intended for marine applications is the primary objective of her research. She obtained her Master's and Bachelor's degrees in Chemical Engineering from Sahand University of Technology and Tehran University in Iran.