THE DEFENSE SERIES

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PROCESSING AND FUNCTIONALITY IMPROVEMENTS OF LAYER-BY-LAYER ASSEMBLED MULTILAYER SUPER GAS BARRIER NANOCOATINGS

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Yixuan Song joined Prof. Jaime Grunlan's research group in Sept. 2014, after receiving his bachelor degree in Tianjin University. His research is focused on thin film gas barrier coatings and gas separation membranes. He published 12 peer-reviewed journal papers (5 first author) in the past three years.

Abstract

Ultra high gas barrier is of great interest in areas of food packaging, pressurized systems, and flexible electronics protection. Although exhibiting good oxygen barrier, the widely used aluminized plastics and inorganic coatings (SiOx and AlxOy) often have poor transparency and/or lack of flexibility. In the present work, layer-by-layer (LbL) assembly is used to prepare transparent, flexible, and high-barrier nanocoatings with polyelectrolytes and clay minerals. For example, a 220 nm thick polyethylenimine (PEI)/vermiculite (VMT) coating improves the oxygen barrier of OPP films by more than 160X, rivaling most inorganic coatings. This excellent oxygen barrier performance is due to the highly exfoliated and almost perfectly aligned clay platelets in the multilayer coating.

This dissertation will describe the optimization of coating recipes and development of new functionalities of LbL nanocoatings. It was found that moderate ionic strength improves the clay alignment and coverage in the coatings. This structural engineering results in a 10X barrier improvement over films prepared without ionic strength altering. A self-healing LbL oxygen barrier will also be presented. High humidity was employed as the healing stimulus, which completely eliminates cracks and restores oxygen barrier. Two more functionalities were developed, including gas separation membranes and polymer actuators. The highly selective CO2/N2 separation membranes are ideal for CO2 capture and removal. The two-way vapor responsive multilayer actuator represents the first demonstration of its kind, showing great potential in applications including sensors and artificial muscles.

Selected Publications


4. Song, Y.; Grunlan, J. “Super Oxygen and Improved Water Vapor Barrier of Polypropylene Film with Polyelectrolyte Multilayer Nanocoatings” Macromol. Rapid Commun. 2016, 37, 963. (front cover article)


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Yixuan Song – Publication List


