Presentation title: Antifouling Coatings from Glassy Polyelectrolyte Multilayer Films

Corresponding Author name: Yuhui Chen, Zachary A. Digby, Joseph B. Schlenoff

Affiliation: Florida State University and the U.S Navy

Ph. No: +1 334-444-7653

Email ID's: Johnola0@gmail.com

WhatsApp No: +1 334-444-7653

Any alternative number:

Other Authors if any:

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Abstract

Coatings that prevent or decrease fouling are sought for many applications, including those that inhibit the attachment of organisms in aquatic environments. To date, antifouling coatings have mostly followed design criteria assembled over decades: surfaces should be well/strongly hydrated, possess low net charge and maintain a hydrophilic character when exposed to the location of use. Thus, polymers based on ethylene glycol or zwitterionic repeat units have been shown to be highly effective. Unfortunately, hydrated materials can be quite soft, limiting their use in some environments. In a major paradigm shift, this work describes *glassy* antifouling films made from certain complexes of positive and negative polyelectrolytes. The dense network of electrostatic interactions yields tough materials below the glass transition temperature, T_g, in normal use, while the highly ionic character of these polyelectrolyte complexes ensures strong hydration. The close proximity of equal numbers of opposite charges within these complexes mimics zwitterionic structures. Films, assembled layer-by-layer from aqueous solutions, contained sulfonated poly(ether ether ketone), SPEEK, a rigid polyelectrolyte which binds strongly to a selection of quaternary ammonium polycations. Layer-by-layer buildup of SPEEK and polycations was linear, indicating strong complexes between polyelectrolytes. Calorimetry also showed complex formation was exothermic. Surfaces coated with these films in the 100 nm thickness range completely resisted adhesion of the common flagellate green algae, *Chlamydomonas reinhardtii* which were removed from surfaces at the minimum applied flow rate of 0.8 cm s^{-1}. The total surface charge density of adsorbed cations, determined with a sensitive radioisotopic label, was very low, around 10% of a monolayer, which minimized adsorption driven by counterion release from the surface. The viscoelastic properties of the complexes, which were stable even in concentrated salt solutions, were explored using rheology of bulk samples. When fully hydrated, their T_gs were observed to be above 75 ^oC.

Biography

John Akintola, PhD has about 10 years-experience of research in areas such as polymer chemistry, synthesis, materials characterization, thin film preparation, surface chemistry, analytical chemistry, oil and gas production chemistry, process monitoring, optimization and pilot-to-scale up design. He is interested in the preparation of novel polymeric materials for various applications such as antifouling coatings, sustainable desiccants, nanocomposites, biocompatible implants. He has worked in several fast-paced and innovative industry positions doing research with materials, and process development.