**Assembly-Driven Tailoring of Layer-by-Layer Polymer Systems**

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**Abstract:**
This presentation will describe investigations of processing-structure-property relationships in polymers and polymer composites, with a focus on interfacial phenomena in layer-by-layer systems (polyelectrolyte and additive manufacturing). Assembly conditions, instead of complex chemistries, are used to modulate both bulk and nanoscale properties and function.

Additive manufacturing (AM) has drawn interest from fields ranging from aerospace to regenerative medicine to metamaterials. With AM, specimens with complex internal geometries and structures can be manufactured. Despite the advantages and interest, broader use of AM is limited by poor mechanical properties, lack of reliable part printing, and lack of expertise in AM. The effect of common print parameters on the properties of material extrusion AM parts was explored using experimental and computational approaches. Upon annealing, specimens deform, exhibiting irreversible thermal strain that increases with decreasing layer thickness, up to 21% strain. Tensile and flexural strength exhibited the same behavior, with maxima at a layer thickness of 200 μm. While residual thermal stress decreases with increasing layer thickness, print quality and relative interlayer diffusion decrease with increasing layer thickness. To better understand this process, a simulation was developed that describes temperature throughout a build. Short times over $T_g$ were reported, indicating limited opportunity for interlayer diffusion. Additionally, maxima in cooling rates were observed for at print speeds of 10-30 mm/s. The results of this work have significant implications for AM, especially with result to reliability and tailorable multifunctionality.

Growth factors (GFs) act as biochemical cues for cells and, as such, are powerful tools for modulating cellular expansion, tissue regeneration, and cancer treatment. However, their application in biomedicine is challenging for reasons including cost, stability, and myriad potential negative outcomes when GF amount and release location are not optimized. Polyelectrolyte multilayers (PEMs) have been designed for controlled release of proteins, for application in *ex vivo* therapeutic cell expansion. Chemistry and structure of the first layer can be used to control structures and properties of PEMs. Sustained release over relevant culture times can be tailored, and GF stability is maintained for at least 5 days at room temperature through encapsulation in a PEM. The role of humidity history and water content in the structure and properties of polyelectrolytes and polyelectrolyte complexes will also be discussed.

**Bio:**
Amy Peterson is an Assistant Professor of Chemical Engineering at Worcester Polytechnic Institute. Her research group studies processing-structure-property relationships in polymers and polymer composites, with a focus on interfacial phenomena in layer-by-layer systems (polyelectrolyte and additive manufacturing). This includes the study of fundamental aspects of polyelectrolyte multilayers and their application in biomedical devices and corrosion resistant coatings, as well as investigation of the effects of assembly conditions on resulting physical and mechanical properties using both experimental and computational techniques. She received her PhD in 2011 from Drexel University, where she was an NSF IGERT and Graduate Research Fellow. She was an Alexander von Humboldt Postdoctoral Fellow at the Max Planck Institute of Colloids and Interfaces 2011-2013.