

Functionalized Nanomaterials at the Interface of Biology and Technology

Nanomaterials, such as block copolymeric membranes and nanodiamonds, can be engineered for a broad range of applications in energy and medicine. This presentation will highlight the relevance of these materials as foundations for device fabrication across the spectrum of biology and technology. For example, we will address the application of biomimetic membranes as matrices for protein reconstitution toward the fabrication of bio-inspired energetic systems. Preserved protein functionality as well as coupling was observed and confirmed through a wide range of assays, demonstrating the potential utility of biology as inspiration for practical device development. In addition to energy applications, copolymer and diamond-based nanomaterials have been applied toward controlled and localized drug delivery for applications in anti-inflammation to protect against implant rejection, and chemotherapy to enhance treatment efficacy by preventing generalized drug elution. Our laboratory has developed nanopolymer and nanodiamond-based therapeutic technologies via material functionalization with anti-inflammatory and chemotherapeutic molecules. This technique has allowed the platform materials to serve as broadly applicable therapeutic delivery systems. In addition to dramatically inhibiting the expression of multiple inflammation genes *in vitro*, these materials were capable of slowly eluting a potent chemotherapeutic in a slow release fashion via drug sequestering behavior. Furthermore, *in vivo* studies using copolymeric interfaces demonstrated material-enabled implant cloaking in an animal model which is envisioned to significantly impact the chronicity of implant functionality. We also interrogated the cyto-regulatory networks via cytokine expression levels (IL-6, TNF α , iNOS) via quantitative PCR and found that the copolymers/nanodiamonds interface well with their surrounding biological environment at a genetic level. Monitoring of internal cellular processes as well as cytokine release at the tissue-nanomaterial interface revealed the absence of basal cellular inflammatory responses for both the nanopolymers and nanodiamonds.