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Study Abroad
MS in Biomedical & Environmental Engineering

Core Faculty Profile

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Research Interests

Active Substrates for the Study of Cellular Gene Program Response to Nanoscale Stimuli

In addition to supporting the activity of a plethora of proteins such as Bacteriorhodopsin from *Halobacterium halobium*, we have utilized copolymeric materials as amphiphilic supports at the air-water interface for the deposition of cellular adhesion factors, anti-inflammatory glucocorticoids, carbon nanotubes, and beyond. By interfacing various cell lines from macrophages to muscle cells with these functional substrates, we have demonstrated dramatic reductions in stress specific cellular gene programs as evidenced by quantitative PCR analysis of mRNA production of inflammatory cytokines such as TNF-α and IL-12 p40 utilizing drug-functionalized polymeric coatings. In addition, we have initiated aggressive programs to examine observed influences of these substrates upon directed cellular architecture formation through chemical and topographical stimuli.

Protein-Functionalized Membranes: From Bioenergetics to Cytomimicry

Membrane proteins and intra/extracellular signaling molecules drive some of nature's most intricate and important processes, from metabolism to energy transduction. Bacteriorhodopsin is capable of collecting sunlight and transducing this stimuli into photoelectric currents as well as transmembrane pH gradient formation enabled by nanoscale actuation/conformational changes of the retinal molecule. The supporting matrix used to preserve protein functionality represents a key advancement towards possessing the robustness that is requisite of protein-based device engineering. In addition, we are constantly seeking new avenues to enhance the biomimicry of these abiotic materials to match desired properties exhibited in nature (e.g. fluidity) while possessing engineered advantages such as increased robustness and configuration versatility.

Nanoscale Medicine: Cellular Interrogation as a Foundation for Next-Generation Therapeutic Technologies

We are developing nanofabricated electrode arrays functionalized with transmembrane internalization-promoting materials to non-invasively investigate cellular activity for both fundamental as well as translational studies. Our work has shown that cells can sense even the smallest artificial features that come into contact with their surfaces by initiating stress and inflammatory responses. As such, novel interrogative technologies must take into consideration how effectively their job can be performed while remaining *cloaked* from the host. In addition, we are developing self-assembling 'molecular glue' that will simultaneously enable electrode insulation and preserved cell-electrode interfacing through bio-adhesion

promoter integration with attenuated inflammation.

Selected Publications

1. D. Ho, B. Chu, H. Lee, and C.D. Montemagno, “Protein-driven Energy Transduction Across Polymeric Biomembranes,” *Nanotechnology* 15 (8), 1084-1094, 2004. [Article downloaded over 1000 times; top 10% of all Institute of Physics (IOP) Publications (Information as of July 2005); News Coverage in Nature (Nanozone) July 20, 2004.]
2. D. Ho, B. Chu, J.J. Schmidt, J., Brooks, E., Montemagno, C.D., “Hybrid Protein/Polymer Biomimetic Membranes,” *IEEE Trans. Nanotechnology*, 3 (2), 256-263, 2004.
3. J. Xi, D. Ho, B. Chu, and C.D. Montemagno, “Lessons Learned From Engineering Biologically-Active Hybrid Nano/Micro-devices,” *Advanced Functional Materials* 15 (8), 1233-1240, 2005. [Feature Article]
4. D. Ho, B. Chu, H. Lee, E.K. Brooks, K. Kuo, and C.D. Montemagno, “Light-Dependent Current Generation Based on Coupled Protein Functionality,” *Nanotechnology* 16 (12), 3120-3132, 2005. [Cover Article]
5. H. Lee, D. Ho, and C.D. Montemagno, “Fluorometric Measurement of Vectorially-Inserted Purple Membrane Activity Across Block Copolymer Thin Films,” *Polymer* 47:2935-2941, (2006).
6. D. Ho, S. Chang, and C.D. Montemagno, “Fabrication of biofunctional nanomaterials via *Escherichia coli* OmpF protein air-water interface insertion/integration with copolymeric amphiphiles,” *Nanomedicine*, 2: 103-112, (2006).
7. D. Ho*, D. Garcia, and C.M. Ho, "Using Advanced Nanomanufacturing and Characterization Modalities Towards the Realization of Bio-Nano-Informatics Systems," accepted to Journal of Nanoscience and Nanotechnology, 6 (4) , 1-17, 2006.
8. D. Ho "Engineering Intelligent Materials for the Interrogation of Bio-robotic Architectures and Regulatory Networks." IEEE Proc. IROS 18 no. 2166 (2006).
9. D. Ho, E.Chow, and G. Cheng "Examination of Basal and Lipopolysaccharide-Induced Cellular Stress Response to Chemical and Topographical Stimuli from Biotic-Abiotic Functionalized Materials." Bio-Nano-Information Fusion Proc., 2:1-4 (2006)
10. D. Choi, A. Fung, H. Moon, E. Kan, D. Ho, and Y. Chen, "Transport of living cells with magnetically assembled nanowires," Biomed. Microdev., accepted for publication (2006).

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