Emboldened Chemotherapy Strategies Through Nanodiamond-drug Hybrids

Huang H.[1,2], Pierstorff E.[1,2], Osawa E.[3], and Ho D.[1,2,4*]

[1]*Department of Biomedical Engineering, Northwestern University, Evanston, Illinois, USA*
[2]*Department of Mechanical Engineering, Northwestern University, Evanston, Illinois, USA*
[3]*Nanocarbon Research Institute Asama Research Extension Center, Shinshu University, Japan*
[4]*Robert H. Lurie Comprehensive Cancer Center, Chicago, Illinois, USA*

Emerging chemotherapeutic strategies will fuse potent pharmacological agents with novel devices for localized drug elution. To formulate the functional foundation of nanodiamond-based localized chemotherapeutic devices, drug-functionalized nanodiamond particles were fabricated through the interaction of Doxorubicin hydrochloride (Dox) with water-suspended nanodiamonds [1]. We have demonstrated the ability to controllably switch Dox release and adsorption, and therefore functionality via controlled interactions with the nanodiamond surface. Furthermore, as Dox is a cytotoxic element, laddering assays confirmed the ability of the nanodiamonds to preserve and facilitate drug delivery and activity upon multiple cell lines including Raw 264.7 murine macrophages and HT-29 human colorectal cancer cells. Also, we interrogated and observed maintained basal levels of a broad range of inflammatory cytokine genes, confirming the innate biocompatibility at the genetic level of the nanodiamonds. To facilitate the ordered deposition of drug-nanodiamond films, we have also developed a methodology of poly-l-lysine mediated templating for multi-layer/multi-drug functionalization for enhanced efficacy [2]. Subsequent studies will explore opportunities of using vapor-deposited polymers to package the nanodiamond matrices to generate drug delivery devices for applications in directed/sustained therapeutic efficacy. These capabilities are expected to impact a broad range of medical fields including cancer, cardiovascular medicine, orthopedics, neurosurgery, and beyond. This in turn confirms the importance of the introduction of nanodiamonds as a transformative modality for nano-engineered medicine.

[1] H. Huang, E. Pierstorff, E. Osawa, and D. Ho, *Nano Lett.* **7**, 3305-3314 (2007).
[2] H. Huang, E. Pierstorff, E. Osawa, and D. Ho, *ACS Nano* **2**, 203-212 (2008).