Nanodiamond platforms for biomedical applications

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Nanodiamonds integrate a broad range of properties that may contribute towards their application as translationally relevant drug delivery agents. For example, they possess unique surface properties that facilitate potent drug binding and sustained drug release, as well as potent interactions with water to promote dispersability in water. In addition, nanodiamonds are capable of delivering a broad range of therapeutic including hydrophilic and hydrophobic small molecules, DNA/siRNA, and therapeutic proteins. Furthermore, initial *in vitro* and *in vivo* studies have shown that nanodiamonds appear to be biocompatible. Recent work has shown that nanodiamonds are capable of mediating significant advancements in areas such as the delivery of chemotherapeutics. For example, our recent studies have demonstrated that nanodiamonds can enhance cancer cell killing efficiency against multiple drug-resistant cancers including breast and liver models *in vivo*. In these studies, normally lethal dosages of doxorubicin, a clinically relevant chemotherapeutic, were bound to the nanodiamond surfaces, resulting not only in reduced toxicity, but further increased efficacy as well [1]. These nanodiamond-bioactive compound complexes were also remarkably scalable, capable of being batch synthesized through a facile process. In addition, nanodiamond-drug complexes did not result in myelosuppression, which is a major dose-limiting side effect of cancer treatment. Beyond the delivery of small molecule drugs, the delivery of nucleic acids by polymer-functionalized nanodiamonds has also revealed a 70-fold enhancement in efficacy with maintained biocompatibility [2].

Towards the development of advanced nanodiamond-based drug delivery and imaging systems, continued work is focused on the synthesis of multifunctional nanodiamond platforms capable of simultaneous targeting, imaging and drug delivery while remaining biocompatible. These systems may be applicable towards the treatment of a spectrum of current medical challenges ranging from cancer to inflammation/wound healing.

[1] E. K. Chow, X.-Q. Zhang, M. Chen, R. Lam, E. Robinson, H. Huang, D. Schaffer, E. Osawa, A. Goga, and D. Ho*, *Science Translational Medicine* **3**, 73ra21 (2011).

[2] X. Zhang, M. Chen, R. Lam, X. Xu, E. Osawa, D. Ho, *ACS Nano*, Epub head of print: DOI: 10.1021/nn900865g (2009).