Rosette Nanotube Coated Iron Oxide and Selenium Nanoparticles to Inhibit Bone Cancer Growth

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When designing drug delivery systems for treating cancerous tissue, one must consider both the enhanced Permeability Retention Effect (EPR) and the Mononuclear Phagocytic System (MPS). The EPR effect suggests that the larger pores of the vasculature in tumors (~ 100 nm) allows for the enhanced retention of nanoparticles. However, these circulating nanoparticles are prone to clearance by the MPS. Nanoparticles can interact with MPS cells and lead to their opsonization. This premature elimination of nanoparticles from circulation will prevent them from accumulating in tumors.

Considering this fact, here, we designed novel materials which can persist in bone tumors and kill bone cancer cells. Selenium (known as an anti-cancer element) and iron oxide (which has good magnetic properties) nanoparticles are critical components to this cancer drug carrying system. Sub 10nm iron oxide and 40nm selenium nanoparticles were synthesized and results were confirmed by TEM. Since most of the therapeutic anti-cancer drugs are hydrophobic, this system was also designed to possess internal hydrophobic properties. Methotrexate is one of the most commonly used therapeutic agents to fight bone cancer cells and is planned to be used in this experimental system. Specifically, Rosette Nanotubes (RNTs) will be used with selenium and iron oxide as novel anti-cancer drug carriers. RNTs are functional, supramolecules, which are hydrophobic in their inner surface. RNTs can either be non-covalently incorporated with

selenium and iron oxide nanoparticles or these nanoparticles can be chemically functionalized inside the hydrophobic inner surface of the RNTs. Either way, we believe that RNTs will act as an 'invisibility cloak' with a longer circulation time to avoid MPS clearance in order to more effectively fight bone cancer.

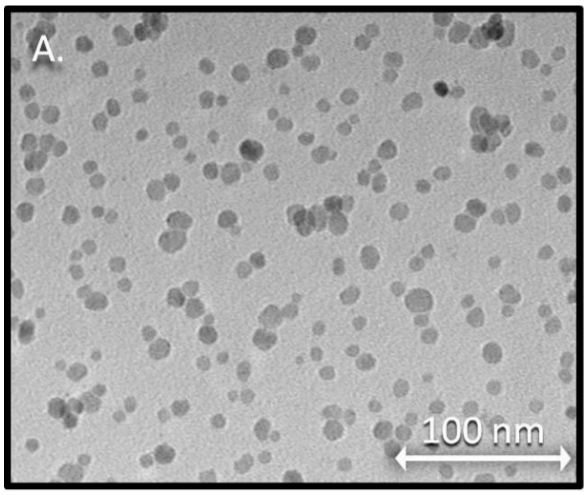

Figure 1A. SPION prepared by refluxing iron (III) acetylacetone in triethylene glycol (TREG) analyzed by transmission electron microscopy (TEM).

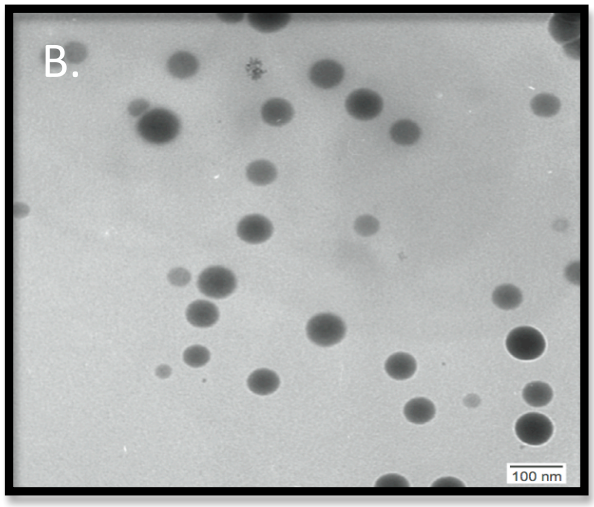

Figure 1B. Selenium nanoparticles stabilized by bovine serum albumin and dispersed in water analyzed by TEM.