

AbstractID: 13061 Title: Nanoparticle Assembled Capsules for Target Drug Delivery, Controlled Release and Hyperthermia

Purpose: To develop a combined targeted, drug release and hyperthermia delivery system for simultaneous multimodality therapy with radiation therapy.

Method and Materials: The system is based on nanoparticle-assembled capsules (NACs) where a polymer, multivalent ion, and a nanoparticle are the only constituents required for self-assembly formation. Poly(allylamine hydrochloride), disodium phosphate, and citrate bound magnetite nanoparticles were used to create the exterior NAC nanoshell, which encapsulates doxorubicin in the microcapsule core. An alternating magnetic field (AMF) of 20 A/m at 267 kHz was used to release the doxorubicin and heat the NAC solution. Three different nanoparticle sizes were used for these studies; 10, 30, and 50 nm to study heating rates and release profiles. **Results:** Magnetic nanoparticle NACs, with doxorubicin cores, were created with dimensions of $\sim 1 \mu\text{m}$ capsule diameter and a $\sim 200 \text{ nm}$ shell thickness. Heating rates of the NAC-solution as a function of particle size were measured. Doxorubicin release profiles were measured as a function of time, nanoparticle size, and concentration. Heating rates were substantially larger for the 50 nm nanoparticles than the 10 nm particles, where temperatures in excess of 90°C over 15 minutes were measured as compared to 70° for the smaller particles. Release rate measurements show that rate is proportional to particle size. Radiation in excess of 100 Gy delivered to the NACs showed no behavioral or morphology change.

Conclusion: We developed a magnetic, nanoparticle-assembled capsule, which is a multifunctional device that can be used simultaneously for both controlled drug release and hyperthermia. The system is controlled externally through magnetic heat loss processes. These devices have many advantages; their surface can be functionalized for molecular targeting in conjunction with external magnetic field gradients and these capsules can easily be scaled up for pharmaceutical production.