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Magneto-optic properties and self-heating behavior of superparamagnetic Fe_3O_4 nanoparticles under alternating magnetic field and near infra-red (785 nm) excitation M.E. SADAT, DONGLU SHI, DAVID B. MAST, University of Cincinnati — The magnetic and optical properties and associated heating behavior in alternating magnetic field and electromagnetic radiation (optical) are investigated on the multifunctional superparamagnetic Fe_3O_4 nanoparticles (SPION) for biomedical applications. It is found that SPION can effectively convert energy into heat under magnetic field and near infra-red (NIR) radiation. A rise of local temperature to 43-45 °C, above the physiological temperature of 37 °C, is achieved by these external fields, which can effectively kill cancer cell. In this work, four different Fe_3O_4 nanoparticle (core diameter 10 nm) systems are investigated. These include: 1) uncoated Fe_3O_4; 2) polyacrylic acid (PAA) coated Fe_3O_4; 3) Fe_3O_4 nanoparticles embedded in the polystyrene nanosphere (NS), and and 4) Fe_3O_4 nanoparticles embedded in the polystyrene NS with silica coating. The PAA coated Fe_3O_4 nanoparticles are found to be more efficient in thermal energy conversion compared to the NS systems. However, the heating rates of these nanoparticle systems are comparable when exposed to NIR (785 nm) light. The different heating behaviors and associated mechanisms are discussed based on magnetic dipole interactions for magnetic hyperthermia and by considering the Drude theory in the case of photothermal effect.

M. E. Sadat
University of Cincinnati

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