Abstract

Magnetic hyperthermia is currently under clinical trials as a less-invasive alternative modality in cancer treatment in conjunction with standard methodologies. Its principle relies on the fact that cancer cells are more sensitive than normal cells in regional temperature changes. Therefore, magnetic nanoparticles acting as hyperthermia agents may be injected either directly or via blood stream to cancer cells, and under alternating magnetic field, release heat locally (reaching temperatures within the range 41-45^{o}C) and lead cancer cells to death (via apoptosis) while normal cells only suffer from a thermal shock. To begin with, manganese and cobalt ferrite nanoparticles were synthesized by a facile, low-cost, environmentally friendly and high yield methodology based on the aqueous coprecipitation of proper salts. Firstly, structural, morphological and magnetic characterizations were performed to determine crucial factors for optimizing their heating potential (such as size, polydispersity, saturation magnetization, coercivity). In order to determine the affection on Specific Loss Power (SLP) and to study the impact of medium properties on heating mechanisms (Brownian and/or Néel relaxation, hysteresis losses) and consequently on AC magnetic hyperthermia, synthesized nanoparticles were dispersed in different mediums with varying concentration and viscosity, namely water and Agarose-gel. Agarose-gel with high viscosity in several concentrations (1%, 5%, 10% w/v in water) was used to mimic human tissue. Eventually, nanoparticles were directly injected in three different cell lines: two human cancer cell lines [human osteosacoma cell line (SaOs-2) and human pancreatic carcinoma cell line (Panc-1)] and one mouse cell line of normal pre-adipocytes (3T3-L1). The heating profile of the particles was studied via its concentration dependence (0.25-16.0 mg/mL) in correlation with their intracellular uptake and cytotoxicity. Our results revealed concentration dependent cytotoxicity profile and uptake efficiency together with variable specific loss power values yet with fast thermal response, opening novel pathways in material selection as hyperthermia agents.