

PEGylated iron-oxide nanoparticles conjugated with curcumin for biomedical applications

K. Kazeli¹, F. Malkaki¹, A. Makridis^{1*}, U. Wiedwald², M. Angelakeris¹

¹ Magnetic Nanostructure Characterization: Technology & Applications, Centre for Interdisciplinary Research and Innovation, Aristotle University, 57001, Thessaloniki, Greece

² Faculty of Physics and Center for Nanointegration (CENIDE) Duisburg-Essen, University of Duisburg-Essen, Lotharstraße 1, 47057 Duisburg, Germany

*anmakrid@auth.gr

Iron-oxide magnetic nanoparticles may serve as drug carriers, remotely manipulated by external magnetic, exhibiting minimal toxicity, without sparing collective magnetic features, when adequately covered and selectively loaded with polymer coatings and active pharmaceutical substances. This study addresses the synthesis of PEGylated iron-oxide nanoparticles via tuneable synthetic routes, i.e. co-precipitation and hydrothermal synthesis. The coating addition of an organic polymer, such as PEG (PolyEthylene Glycol) has been chosen, initially because PEG is hydrophilic and biocompatible, secondly because it assists in size, shape, colloidal stabilization and thirdly it may facilitate their eventual after-effect extraction. The load under study is curcumin, an active/pharmaceutical substance, with anti-inflammatory, antioxidant and anti-cancer features.

Structure, morphology and long-range order outlined the crystallinity, shape, size distribution, PEGylated surface formation and colloidal stability together with further functionalization perspectives. Vibrating sample magnetometry revealed the role of coatings in collective magnetic features i.e. saturation magnetization and coercivity sustaining the superparamagnetic features of the as prepared nanoparticles also after functionalization steps with PEG coverage and curcumin loading (Figure 1a).

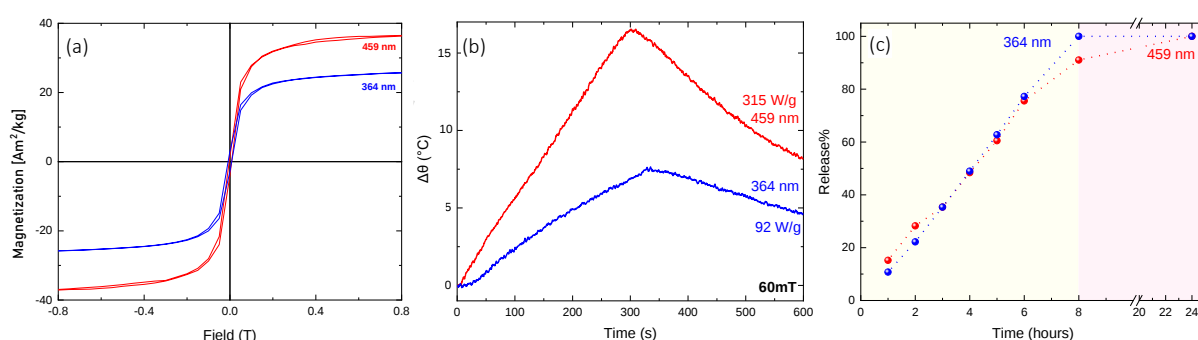


Figure 1. Pegylated iron-oxide nanoparticles conjugated with curcumin of hydrodynamic sizes 364 and 459 nm respectively (a) Room temperature hysteresis loops (b) Magnetic Particle Hyperthermia curves (c) Curcumin release profiles.

Figure 1b depicts the Magnetic Particle Hyperthermia evaluation of Pegylated iron-oxide nanoparticles conjugated with curcumin measured under 375 kHz/60 mT magnetic field. Specific loss power values (W/g) increase with saturation magnetization showing exploitable impact as hyperthermia agents. Figure 1c shows curcumin release at 37 °C in Phosphate-Buffered Saline buffer solution at a thermoshaker. Both samples show an increasing trend in drug concentration release over time, indicating sustainable release of curcumin. The initial burst release is evident in the first 2h interval approaching ~ 16% and reaching values >80 % by the 8h.

Such functionalities show perspectives for future Alzheimer's disease treatments, combining an effective therapy scheme based on curcumin, with minimum side effects, together with advanced diagnostic capabilities, due to nanoparticle magnetic features that allow for non-invasive tracking and imaging.

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