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Morphologically Driven Magnetic Fluid Hyperthermic Properties of Mn0.5Zn0.5Fe2O4-based Magnetic Fluid

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Magnetic fluid hyperthermia (MFH) is a promising cancer therapy based on heat generation from magnetic nanoparticles (MNPs) under an alternating magnetic field of high frequencies. Controlling the hyperthermia temperature between 42–46 ℃ is crucial to avoid overheating. The Mn0.5Zn0.5Fe2O4, with its low Curie temperature (TC) and high pyromagnetic coefficient, makes it a compelling candidate for this purpose.

Various particle shapes, including flower, cube, octahedral, ring, rod and needle, were synthesized to evaluate their structural, magnetic, and heating properties. Magnetic measurements (M vs. H) were conducted at 300 K and 5 K, along with temperature-dependent magnetization under a 1 T field. Curie temperatures were determined using Bloch's law fitting. The results of the study are shown in Fig. 1. The hyperthermic response of all samples were checked at 330 kHz and 10 k/m field with 2 mg/ml concentration. A strong dependence of heating efficiency on particle shape was observed, with the needle-shaped (Rods-2) MNPs demonstrating the highest specific absorption rate (SAR) and fastest temperature rise. These findings highlight the importance of nanoparticle morphology in tailoring magnetic behaviour and enhancing heating efficiency for MFH applications.

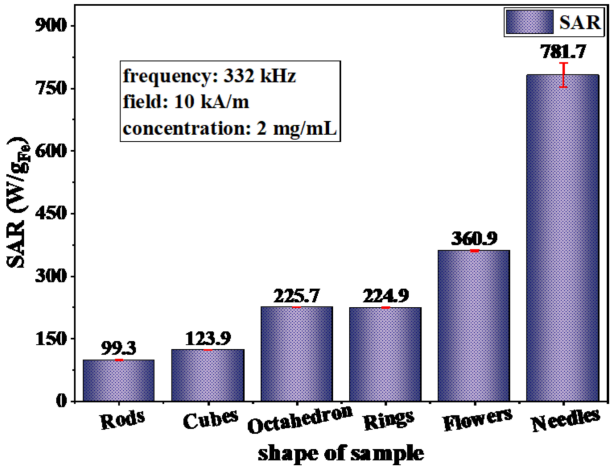

Figure 1: SAR versus particle shapes for Mn0.5Zn0.5Fe2O4 magnetic fluids.

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