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Magnetic Field amplitude optimization for uniform heat dissipation in magnetic hyperthermia

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Magnetic particle hyperthermia (MPH) has gained considerable attention as a targeted thermal cancer therapy. In MFH both the ensemble-averaged performance output and the local uniformity of heat deposition are equally critical to treatment efficacy [1]. This work theoretically investigates how shape-induced anisotropy polydispersity and AC field amplitude jointly govern the magnitude and heterogeneity of local heating in magnetite nanoparticle assemblies [2].

Micromagnetic simulations based on the nonlinear Landau–Lifshitz–Gilbert (LLG) formalism are performed within a macrospin framework that explicitly incorporates both intrinsic cubic magnetocrystalline anisotropy and shape-induced uniaxial anisotropy contributions [3]. For particles in the 25–30 nm size range, an intermediate applied field (4–12 mT) is identified as optimal, simultaneously suppressing single-particle SLP variance while sustaining high ensemble-averaged power output. Notably, the optimal field condition is governed predominantly by particle size and driving frequency, with shape dispersity exerting only a secondary influence. These results offer quantitative design criteria for MFH optimization and highlight the necessity of accounting for compound anisotropy contributions —both crystalline and morphological —in physically realistic nanoparticle systems [4].

References

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