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# On the importance and estimation of local heat dissipation of interacting magnetic nanoparticles subjected to an applied magnetic field

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Controlling the heat dissipated by magnetic nanoparticles (MNPs) subjected to an alternating magnetic field HAC is crucial for the effectiveness of several applications such as heat-mediated drug delivery, which uses the heat generated by MNPs attached to some thermo-sensitive carrier to activate the release of the drug; or magnetic fluid hyperthermia (MFH), a promising technique for cancer treatment which uses the heat released by MNPs under AC fields to damage the cancer cells. Some experiments1,2,3 reported that during the exposure of MNPs to an AC field, the temperature may increase several tens of kelvins at the particle surface and then rapidly decay to zero only a few nanometers away. Therefore, addressing the local (at individual particle level) heat dissipation becomes very relevant4.
In MFH, global (whole system) heat dissipation is usually obtained from the area of the magnetization vs. applied field M(H) hysteresis loops. However, using the same approach for local hysteresis cycles is not adequate for strong-interacting systems because coupled particles may have inverted hysteresis loops and therefore negative hysteresis areas.
The aim of this work is to find an alternative way to evaluate local released energy. To do so, we work with the kinetic Monte Carlo technique, which is suitable to describe heating processes of interacting particle systems5. Our premise is that the hysteresis area of the entire system stands for the total dissipated energy. We developed an approach where we analyze the different types of jumps of the energies of individual particles and from there we are able recover the area of the entire system.

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