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Magnetic hypertermia investigation of nanoparticles with SANS

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One of the most promising medical applications of magnetic nanoparticles (MNPs) is cancer therapy through magnetic hyperthermia and externally controlled drug delivery. The latter could be achieved by a phase transition of lipid nanoparticles with embedded iron oxide nanoparticles, as demonstrated in [1,2]. In such systems, external high-frequency magnetic fields can generate the heat required for the phase transition. Optimizing the field parameters is crucial, as the ultimate goal is clinical application. Small angle neutron scattering (SANS) is an ideal technique for the in-situ characterization of the magnetic response of MNPs. However, creating and controlling the magnetic field and heating power of the MNPs requires a dedicated setup compatible with the conditions of a neutron beamline.

To address this, a custom setup was prepared and used at the SANS instrument ZOOM ISIS Neutron and Muon Source research center in the UK. This proof of concept involved an AC oscillating circuit for field generation and an externally mounted pyrometer for heating control. The setup is an LC-resonator driven by a generator and amplifier. It includes a rotary capacitor with adjustable capacity and a coil. The setup is optimized for frequencies ranging from (50-600) kHz and can generate field amplitudes up to 60 Gauss. We present the experimental results, where the setup was used to examine the phase transition of a lipid nanoparticle solution under the influence of the RF magnetic field.

[1] Mendozza, M., et al. (2018). Nanoscale, 10(7), 3480–3488. https://doi.org/10.1039/c7nr08478a
[2] Caselli, L., et al. (2021) International Journal of Molecular Sciences, 22(17). https://doi.org/10.3390/ijms22179268

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Sitzung Einordnung: Mounting Posters, Beer and light Dinner

Track Klassifizierung: Magnetism & Superconductivity