

## Contribution submission to the conference Dresden 2026

### Optimization of metal-doped $M_{0.2}Fe_{2.8}O_4$ /PEG nanocomposite for enhanced magnetic and relaxometric performance in MRI applications —

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Magnetic spinel ferrites are promising magnetic resonance imaging (MRI) contrast agents owing to their tunable structure, magnetic anisotropy, and biocompatibility.  $M_{0.2}Fe_{2.8}O_4$  nanoparticles ( $M = Fe^{2+}, Mn^{2+}, Cu^{2+}$ ) coated Polyethylene glycol (30%PEG-6000) were synthesized to correlate cation substitution with structural, magnetic, and relaxometric behavior. XRD, HRTEM, FTIR, XPS, synchrotron-based XAFS spectroscopy, and Vibrating Sample Magnetometer (VSM) confirmed single-phase nanocrystals (8-13 nm) with mixed  $Fe^{2+}/Fe^{3+}$  states and preserved spinel geometry upon PEG coating. Mn-doping enhanced saturation magnetization and transverse relaxivity, providing the strongest T2 weighted MRI contrast. The results demonstrate that combining controlled B-site substitution with hydrophilic PEG capping enables concurrent optimization of magnetic response and colloidal stability, highlighting  $Mn_{0.2}Fe_{2.8}O_4$ /PEG as a high-performance and biocompatible MRI nanocontrast agent.

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