Optimizing magnetic recording media for nanoparticle self-assembly: Using non-magnetic layer substitution to isolate hard layer magnetism

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Introduction: Commercial magnetic recording media has been adapted to create templates for magnetic nanoparticle self-assembly [1]. However, many media attributes critical for storing information are not necessary for self-assembly, for example thermal stability over long time scales and sub-nanosecond switching speeds. Thus commercial media is not engineered specifically for self-assembly.

Methodology: Here we adjust the properties of perpendicular media to better tune it for templating complex self-assembled nanoparticle patterns. Since perpendicular recording requires deposition of a soft magnetic underlayer (SUL) beneath the media, which acts as part of the write head during recording, we require an SUL beneath our customized media as well. Regardless of application, magnetic characterization of the media layer with a Vibrating Sample Magnetometer (VSM) is hampered by the presence of the SUL (in our case Permalloy, $Ni_{80}Fe_{20}$), which contributes a large signal as seen in Fig. 1 [2]. By replacing the SUL with Cu, which is non-magnetic but has similar crystal structure and lattice parameters to Permalloy [3], we create a composite response by adding the signal from a recording layer only sample (Si/Ag/Cu/Ti/CoCrPt) to a SUL-only sample (Si/Ag/NiFe/Ti).

Results and Conclusion: Fig. 1 compares the hysteresis loop of the added signals with the loop from a sample with both layers (Si/Ag/NiFe/Ti/CoCrPt). The full sample loop shows a clear pinching (Fig. 1 inset), which likely indicates antiferromagnetic coupling between the layers [4], that is absent in the summed independent layer data.

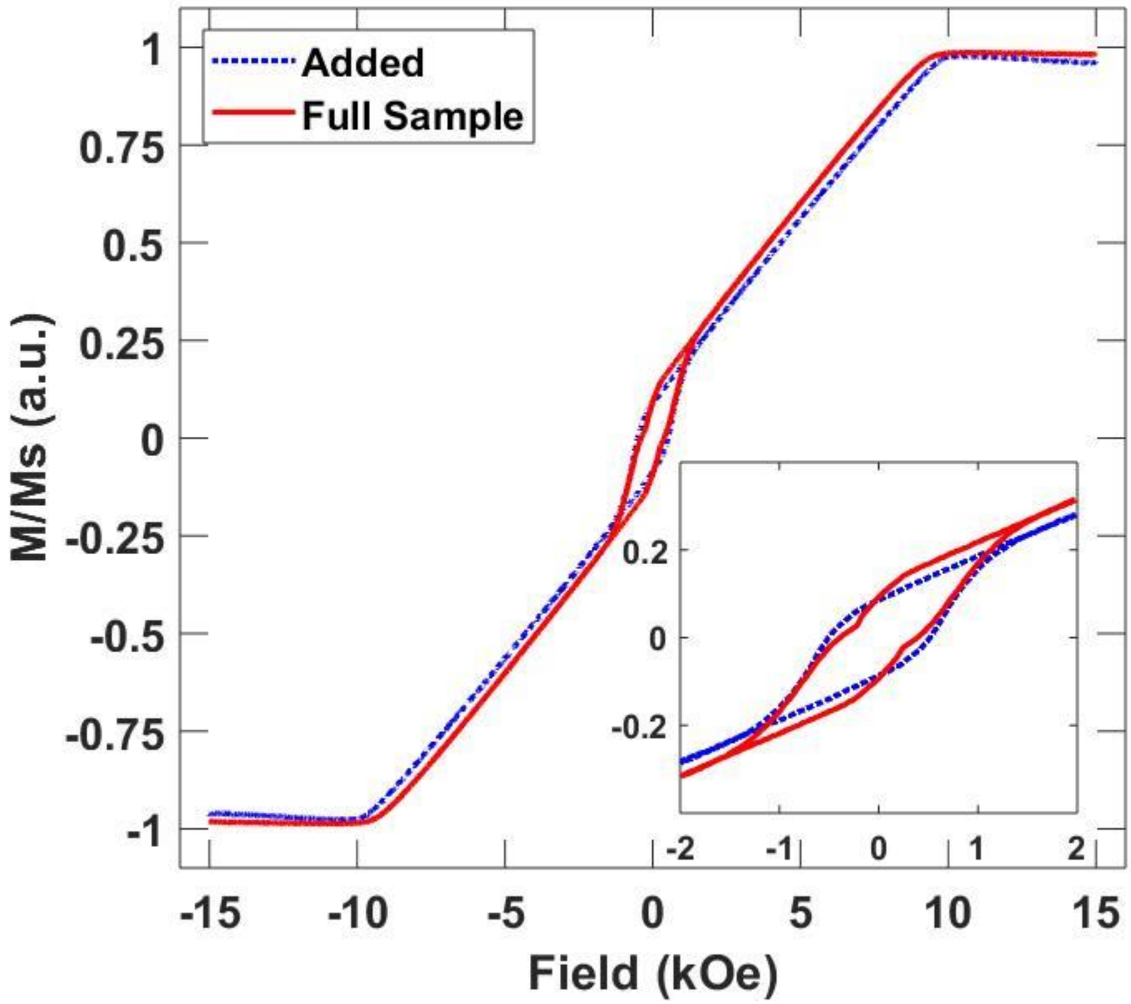

Fig. 1 VSM data for full and summed signals. Inset: pinching in the full sample loop.

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