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Between single ion magnets and macromolecules: self-organizing, polymer-transition metal based macromolecular magnetic semi-solid solution

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We present a new approach to obtain functional magnetic materials: one that combines the qualities of polymers that are widely used to produce thin films, and Single Ion Magnets that exhibit magnetic relaxations.[1] By reactions of pyridine and 4-vinylpyridine with $CoBr_2$, we obtained two SIMs, showing field-induced relaxations of magnetization with energy barriers of 28(2) and 35(3) K, and τ_0 values of $8 \cdot 10^{-10}$ s and $1 \cdot 10^{-11}$ s, respectively. Next, resulting from a reaction of poly(4-vinylpyridine) (P4VP), with its structural units identical to the ligands used to form the SIMs, with $CoBr_2$, a new material was formed with $CoBr_2$ bound to the pyridines within the polymer chains, forming a cross-linked macromolecular matrix. Field-induced relaxations of magnetization are preserved and dependent on the Co:P4VP structural units molar ratio, making it an amorphous semi-solid solution. Thin magnetic films were obtained by immersion of P4VP spin-cast films in $CoBr_2$ orthogonal solution. Atomic Force Microscopy (see figure, middle), Secondary Ion Mass Spectrometry and X-ray Photoelectron Spectroscopy confirm the binding of cobalt salts within the layer. AC magnetic measurements confirm the preservation of magnetic relaxations in the film. We believe that our research opens a new path that combines two fields of material research and is extremely promising regarding future applications of molecular magnets –as self-organizing macromolecular magnetic materials.

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[1] G. A. Craig, M. Murrie, *Chem. Soc. Rev.*, 2015, **44**, 2135-2147.

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