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Water-induced selective crystallization of finite or infinite Single Chain Magnets

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The Digital Revolution is a part of our daily life for a few decades now, with the democratisation of the computers, Internet, cell phones and other connected devices. Adding to this, the upcoming rise of cloud computing, streaming and artificial intelligence will lead to an exponential growth of data consumption (and de facto its storage). To tackle this issue, a net increase of the areal density of hard drive disks will be needed, by miniaturizing the size of its elementary storage units.

With this aim in mind, physicists and coordination chemists have designed jointly promising molecular magnets[1], able to store information by addressing its spin orientation (↑ = 1 and ↓ = 0 for example) at the nanoscale level, and working up to the liquid nitrogen temperature[2]. However, these 0D molecular magnets, called Single-Molecule Magnets (SMMs), are subject to parasitic demagnetization effects (such as quantum tunnelling, Raman, etc), less relevant in the case for infinite Single-Chain Magnets (SCMs) because of their mesoscopic nature[3].

Taking this into consideration, we have synthesised two new SCMs based on a strongly anisotropic magnetic centre, the $Tb(hfac)_3$, and a bridging nitronyl nitroxide (NIT) radical, the NITPhOHexyl. By monitoring the crystallization conditions, we have shown that we can selectively obtain either a chiral helical chain[4] or a finite hexanuclear complex depending on the presence of atmospheric water or not. Surprisingly, if a magnetic SCM behavior was expected for the chain, the finite hexanuclear complex share similar properties, usually observed only for infinite molecules.

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