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The role of neutron diffraction in understanding magnetization tuning of MnCO3 by Amino Acids incorporation

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Incorporation of organic molecules into the lattice of inorganic crystalline hosts is a common phenomenon in biomineralization and is shown to alter various properties of the crystalline host. Recently, we manipulated magnetism in $MnCO_3$ by admitting a specific single amino acid into its lattice matrix. Bulk measurements showed a clear negative (positive) correlation between amount of incorporated acid and Néel temperature (low temperature magnetic susceptibility under high magnetic field). Preliminary neutron diffraction results supported these findings and added to them clear observation of significant reduction in ordered magnetic moment values as well as splitting of oxygen atomic positions as the amount of incorporated amino acid is increased. Advanced, high resolution neutron diffraction data further suggest stress anisotropy caused by the amino acid as it is incorporated into the lattice, manifested by a high stress component along the hexagonal unique axis. These findings support the weakening of the super-exchange interactions in MnCO3 by multiple mechanisms, e.g. lattice distortion, lattice stress, and anisotropic bond-length expansion. It may be that this is the first time that the magnetic properties of a host crystal are tuned via the incorporation of amino acids, and neutron diffraction is a key method to explain the fundamental process of it.

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