

Non-reversible Photoinduced Phase Transition in the RbMnFe Prussian Blue Analogue Studied by Streaming Crystallography

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Modern ultrafast technologies have opened new perspectives in controlling bistable magnetic materials, where light can be used to switch between different phases and thus different properties [1]. Ultrafast photo-switching within bistability regimes indeed promises enhanced control of bistability down to ultrashort timescales. Among the available bistable materials, Prussian Blue Analogues (PBAs) are cyano-bridged bimetallic compounds with a phase transition based on a charge transfer between two stable states of different spin [2]. Moreover, the electronic charge transfer is coupled to symmetry breaking and large volume change, leading to a wide bistability hysteresis [3].

In this work, we followed the multiscale dynamics of the photoinduced phase transition within the thermal hysteresis of RbMnFe PBA micro-crystals (Figure 1) [4,5]. This was made possible by developing a new streaming crystallography method for time-resolved X-ray diffraction studies of non-reversible phenomena. Our results reveal that, above threshold excitation, complete photo-transformation from tetragonal to cubic phases can be achieved down to ultrashort timescales, leading to a permanent photo-induced phase. The out-of-equilibrium and multiscale dynamical behavior results from the coupling of volume strain driven by photoinduced charge transfer and symmetry change [5]. More generally, these results open a broad field of dynamical studies for photo-switching in bistable materials through ultrafast crystallography.

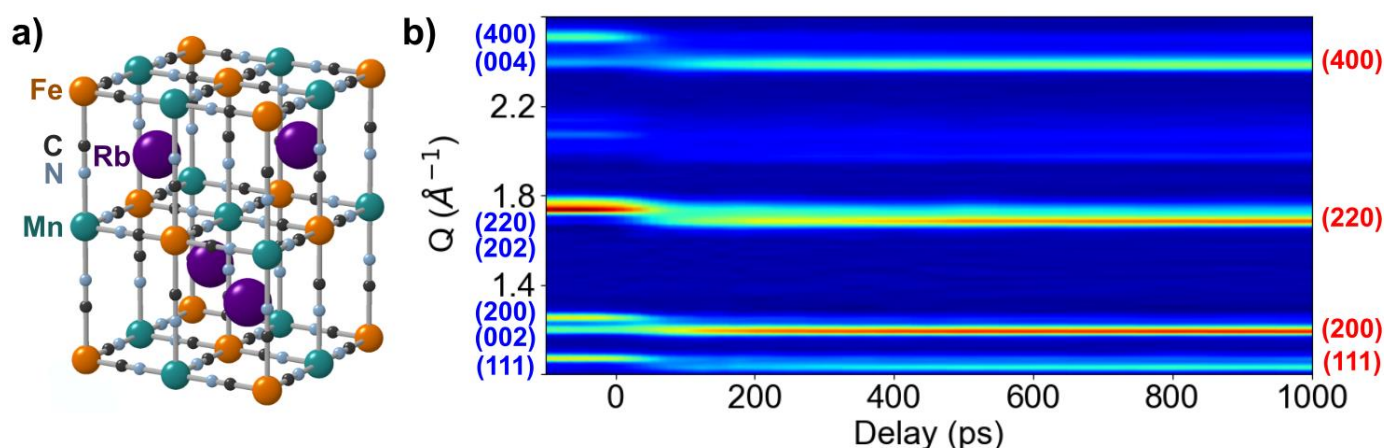


Figure: a) Structure of the RbMnFe PBA; b) Time-resolved X-ray diffraction pattern of RbMnFe, with (hkl) indices for the initial, tetragonal (left, in blue) and final, cubic (right, in red) phases.

References:

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