Femtosecond Spin-State Photoswitching of Molecular Nanocrystals

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Controlling molecular states in a solid material with an ultrashort laser pulse poses a new challenge to the ultrafast science, ensuing the now established field of femtochemistry. Molecular materials can be directed between different macroscopic states by using appropriate electronic, or other, excitations. By contrast to a dilute solute in a passive solvent, all molecules that make up a solid are active and can be switched. Emerging cooperativity and coherence of different degrees of freedom underpin the resulting phase transitions of various sorts. The pertinent time scales for photo-switching processes in materials have been rather difficult to scrutinise. The pioneering investigations dealt mainly with the electron/phonon dynamics immediately following the femtosecond excitation, or the kinetics of recovery to the thermally stable states. In solids, we can expect the dynamics to follow a complex pathway from molecular to material scale through a sequence of processes. Spin-crossover (SCO) compounds are excellent photo-active prototypes by virtue of their photo-magnetic properties, which can be switched by promoting the constituent molecules to their low-spin or high-spin electronic states. We scrutinise the switching timescales and the underlying mechanisms by investigating the SCO single crystals [1-3] and the SCO nanocrystal films [4].

References

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