Role of oxygen coordination on the ultrafast demagnetization in ferrite nanoparticles

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We studied the ultrafast dynamics of charges and spins in assemblies of Fe_3O_4 and $\gamma\_Fe_2O_3$ nanoparticles. These nanostructures stimulate much interest due to their potential applications in several fields. Generally, these two structural phases of iron oxide are hardly distinguishable. We demonstrate that using time-resolved magneto-optics one is able to disentangle those very similar iron oxide structures. The Fe_3O_4 nanoparticles are elaborated by hydrothermal decomposition and deposited by drop on a glass substrate. $\gamma\_Fe_2O_3$ nanoparticles assemblies have been obtained by annealing the Fe_3O_4 nanoparticles. Comparing time resolved transmission and Faraday rotation, our measurements show that in case of Fe_3O_4 the demagnetization occurs after the thermalization of the charges, as expected from previous works on ultrafast quenching of magnetization in ferromagnetic nanostructures. On the contrary, in the case of maghemite nanoparticles, an acceleration of the demagnetizing occurs, leading to a simultaneous charges and spins dynamics. We attribute this behavior to the rearrangement of vacancies and annealing of crystal defects in maghemite.