Iron oxide nanoparticles (IONs) may well represent the most promising magnetic nanostructures for a plethora of applications in health, life and environmental science. IONs are already used in medicine, catalysis and downstream processing of biotechnological products. Since most particles, utilized industrially, need expensive coatings, the application of bare nanoparticles seems economically worthwhile. In this study, three different ION species were synthesized by co-precipitation methods without stabilizing agents and were thoroughly characterized with a multi-analytical approach. We emphasize the importance of the particle characterization as transitions of the ION polymorphs into each other are possible as well as merging of distinct properties. The particle sizes, which here range from 10 to 30 nm, and the magnetic properties of IONs are crucial for the further application. The adsorption behavior of the enzyme cellulase (CEL) as a model protein is investigated on the different IONs in order to gain deeper insights into bio-nano interactions to different surface sites, charges, curvatures and morphologies, as given by the three applied adsorber materials. The protein-particle interactions are driven by electrostatic and hydrophobic forces in the case of CEL. The CEL adsorption follows a Langmuir behavior and does not exceed maximum loads of around 0.6 g g$^{-1}$. IR spectroscopy gives insights...
into the orientation of bound CEL and indicates a stronger affinity for the β-sheet tertiary structure content while a higher load can be reached with a higher α-helix content.