25e Congrès Général de la Société Française de Physique

Contribution ID: **188** Type: **Orale**

Real-time x-ray probing of the semiconductor to metal ultrafast phase transition in Titanium Pentaoxyde nanocrystals

Friday, 12 July 2019 09:00 (15 minutes)

Since the 2000's and the pionnering Time-Resolved X-ray diffraction experiments (TR-XRD), we can now "see" atomic motions in real time on femtoseconde time scales. Today's challenge is not only to see but also to to "act" on matter in an ultra-fast and controlled manner. This means inducing an ultrafast permanent change, ultimately reversible, in a material. This requires a deep understanding of the ultrafast structural dynamics but also the propagation process of the induced deformation on longer time and space scales. It was recently demonstrated experimentally and theoretically a self-amplified responsiveness in a spin-crossover material [1] during its delayed volume expansion.
Our talk will focus on Titanium Pentaoxide, a prototype of multistability which undergoes phase transitions between different forms (so called α,β,λ), that can be monitored by temperature, pressure, electric field and laser pulses. The stability of the phases is strongly related to the size of the crystallites. In particular the nanocrystals are bi-stable up to room temperature with obvious interest for pure and applied science[3,4] (fig. 1). The results of TR-XRD experiment performed on Bernina@SwissFel will be presented. It allowed for the first time a complete quantitative analysis (Rietvelt analysis) of the ultrafast growing and structural distorsions (volume expansion...) of the photo-induced phase.

Choix de session parallèle

6.4 Résultats scientifiques récents obtenus avec les XFEL

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Session Classification: Séance Parallèle