Advanced 0-D to 3-D electron microscopy: from the detection of single atoms in doped YAG to 3D information on functional nanomaterials

Recent developments in transmission electron microscopy have proven to be one of the major thrusts in elucidating unsolved issues in materials science. This workshop hence served as an international platform for interactions among researchers in different disciplines, covering magnetic nanoparticles to optical ceramics, with common interests of making the best of modern microscopy techniques.

The main purpose of the workshop is twofold. First, we aim to elucidate the chemical and crystallographic structure of ceramic materials at the atomic level. Especially we have applied several characterization techniques, including Cs-corrected high-resolution TEM and atomic resolution STEM, in order to directly visualize the distribution of rare-earth dopant atoms in oxides for optical applications. Secondly, we intended to relate these structural characteristics of oxides to their physical properties, especially optical behaviors, such as absorption and fluorescence responses, and feedback them to the processing conditions,

Therefore, the participants and topics include Florent Tournus, INSA Lyon, France, ("Structure and magnetic properties of FeRh nanocrystals"), Martin Nikl, Institute of Physics, Czech Republic, ("Inorganic scintillation nanopowders and nanocomposites"), Christophe Dujardin, LPCML, Université Claude Bernard Lyon 1, France, ("Spacial distribution of luminescence in various systems), and Thierry Epicier, INSA Lyon, ("Atomic STEM studies by coupled HAADF imaging and EELS chemical analysis"). Together with three presentations from IMR, from both processing and characterization points of views, discussions have been focused as to making the best usage of versatile but wide-ranging imaging and analytical techniques.

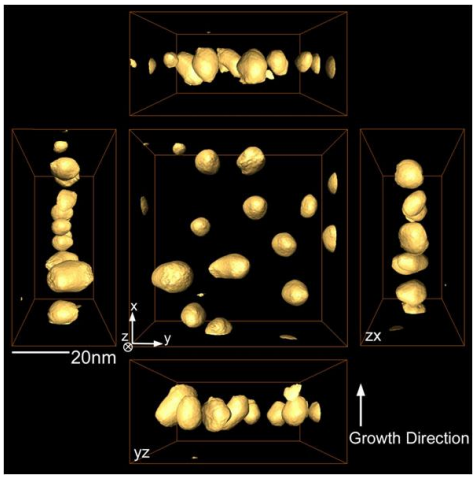

Fig. 1 3D tomographic images of magnetic nanoparticles

Figure 1 shows a distribution of FePd magentic nanoparticles, reconstructed by SIRT method. As seen, three-dimensional feature is well visualized by using tomographic technique. However, a detailed analysis has disclosed non-negligible errors in the length estimation, especially in the z-direction.

Figure 2 shows STEM-HAADF image of a misfit dislocation at the bottom of a $PbTiO_3$ film deposited on a $SrTiO_3$ substrate. Distribution of strains within the film was quantitatively revealed by applying a strain analytical method, called geometrical phase analysis. This kind of defects acts as a source for 90° domain walls. [2]

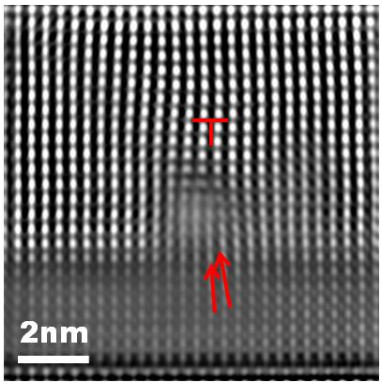

Fig. 2 STEM-HAADF image of $SrTiO_3$-$PbTiO_3$ interface, showing a misfit dislocation.

References

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[2] T. Kiguchi, K. Aoyagi, Y. Ehara, H. Funakubo, T. Yamada, N. Usami, T.J. Konno, Sci. Technol. Adv. Mater. 12, 034413 (2011)

Keywords: electron microscopy, microstructure, nanoparticles, ceramic, optical properties
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