CENTRE FOR ELECTRON MICROSCOPY AND MICROANALYSIS (CEMM)

Centre for electron microscopy and microanalysis (CEMM) is instrumental centre at JSI, which combines analytical equipment in the field of electron microscopy and microanalysis. The access to research equipment of CEMM has, besides other JSI departments, also other research institutions, universities and industrial partners. Equipment at CEMM is used by researchers, interested in morphology and structural and chemical characterization of materials between micrometre and atomic level. At CEMM there are three scanning electron microscopes (JSM-5800, JXA-840A, JSM-7600F), two transmission electron microscopes (JEM-2100 (CO NIN), JEM-2010F) and the equipment for sample preparation. CO NAMASTE contributed to the equipment for electron microscopy with CCD camera and ADF detector for JEM-2010F microscope and EBSD system for JSM-7600F. Additionally, IJS is co-owner of Jeol ARM 200F (scanning transmission electron microscope).

Research, involving staff and equipment at CEMM, are diverse regarding investigated materials and also used methods. Scanning electron microscopy (SEM) is used to observe the morphology and structure of surfaces and for microstructural investigation and determination of the chemical composition of polycrystalline oxide and non-oxide ceramic materials, nanostructures, metallic magnetic materials, metals, alloys glass, etc. All of the scanning electron microscopes in CEMM are equipped with an energy-dispersion (EDXS) and / or the wavelength dispersion (WDXS) spectrometers of X-rays, allowing non-destructive determination of the chemical composition of the investigated materials. The scanning electron microscope JSM-7600F is additionally equipped with electron back-scattered diffraction (EBSD) detector and electron lithography system.

Transmission electron microscopy (TEM) enables an insight into structure of the material in the nano-scale. Transmission electron microscopy enables structural and chemical analyses of the grain boundaries, planar defects, dislocations and precipitates. Transmission electron microscope JEM-2100 is equipped with EDXS spectrometer and CCD camera, and JEM-2010F is additionally equipped with STEM unit, EDXS and EELS spectrometers, and a CCD camera. CEMM also manages the necessary equipment for the SEM and TEM sample preparation.

Operation of the Centre is managed by properly trained employees. Beside maintenance of the equipment, among other CEMM activities are training of new operators, organization of workshops and conferences on the topic of electron microscopy, providing services for industrial partners and the introduction of new analytical techniques. CEMM personnel are also responsible for demonstration of electron microscopy to the general public in scope of organized visits at IJS, as well through publications in traditional and digital media. For users of microscopes CEMM organized the 5th workshop (vacuum in electron microscopy, sample preparation for SEM, scanning electron microscope). The aim of the workshops was to present the operation of the equipment and preparation techniques for SEM samples.

5th Workshop, CEMM (Koblar M)

Individual research works and analysis using CEMM equipment:

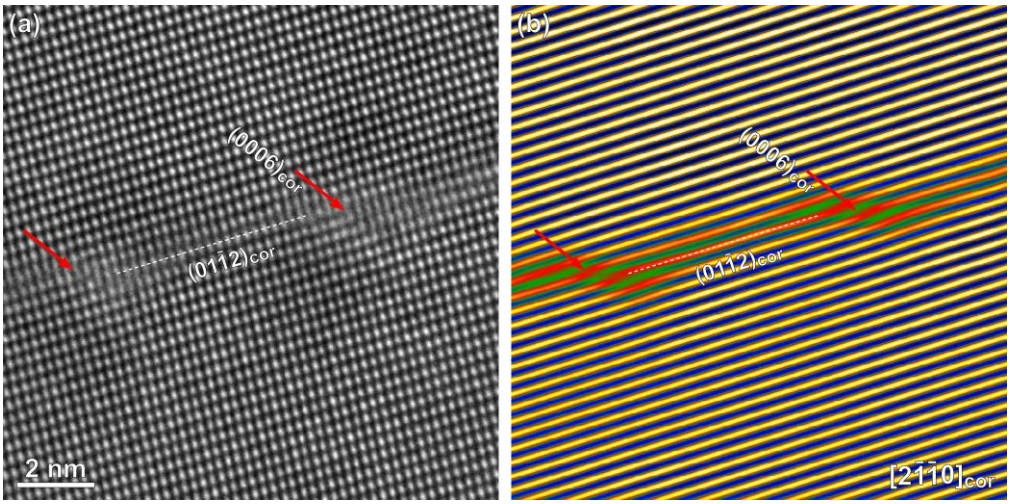

Figure 1: (a) HRTEM image of an interface in hydrothermally grown ruby with characteristic dilatation at the contact area of the two corundum domains and (b) geometric phase analysis of the interface. The dilatation is caused by trapped OH-groups at the contact (Daneu N, Rečnik A, *JEM 2010F*)..

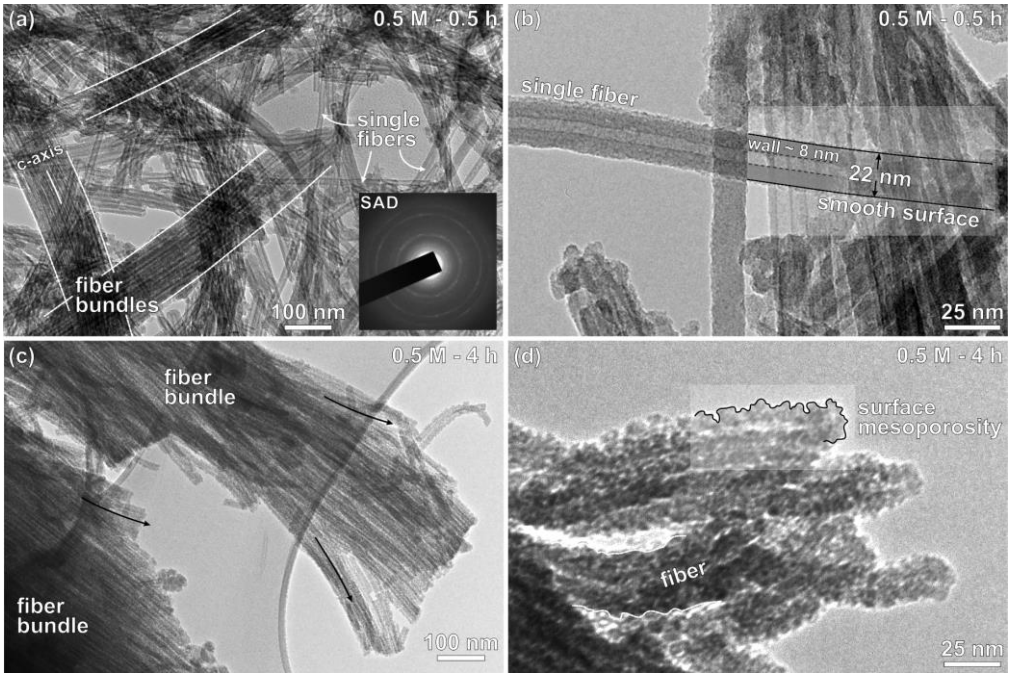

Figure 2: (a,b) Chrysotile fibers before and (c,d) after treatment with 0.5 M HCl showing the development of surface mesoporosity on the surface of the fibers (Daneu N, *JEM 2100*).

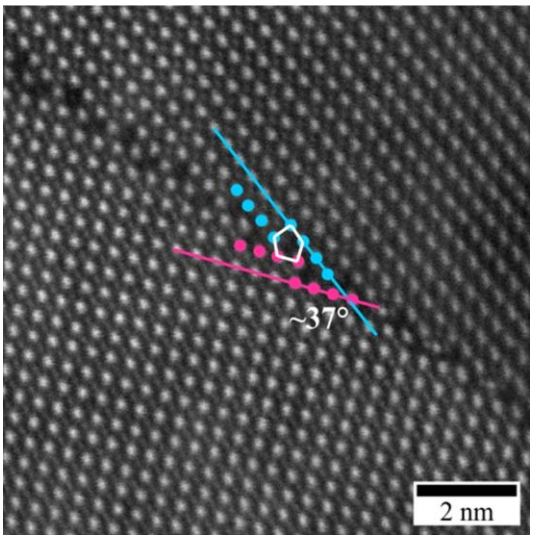

Figure 3: Atomic scale micrograph of a clean, high-angle grain boundary in potassium sodium niobate doped with strontium. The micrograph was made with a scanning transmission electron microscope (Hreščak J, *JEM 2010F*).

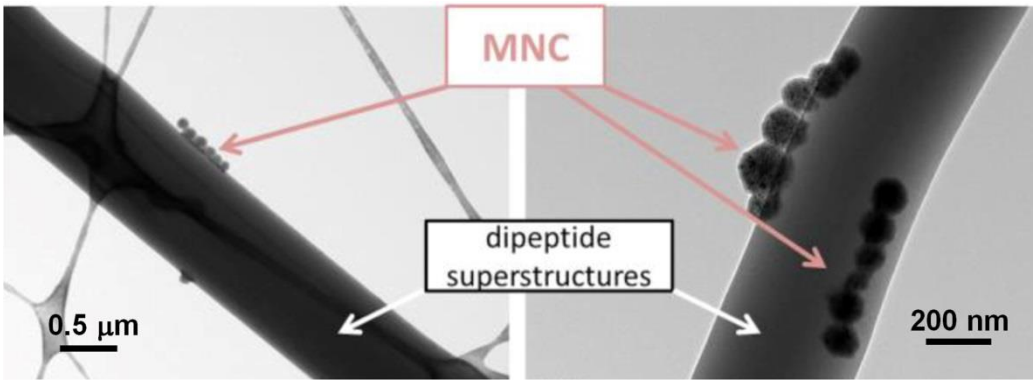

Figure 4: Transmission electron microscopy (TEM) images of silica-coated chains of superparamagnetic nanoparticles clusters (nanochains MNC) attached at the s the nanocomposites composed of self-assembled dipeptide (Phe-Phe) fibres (Kralj S*, JSM 2100*).

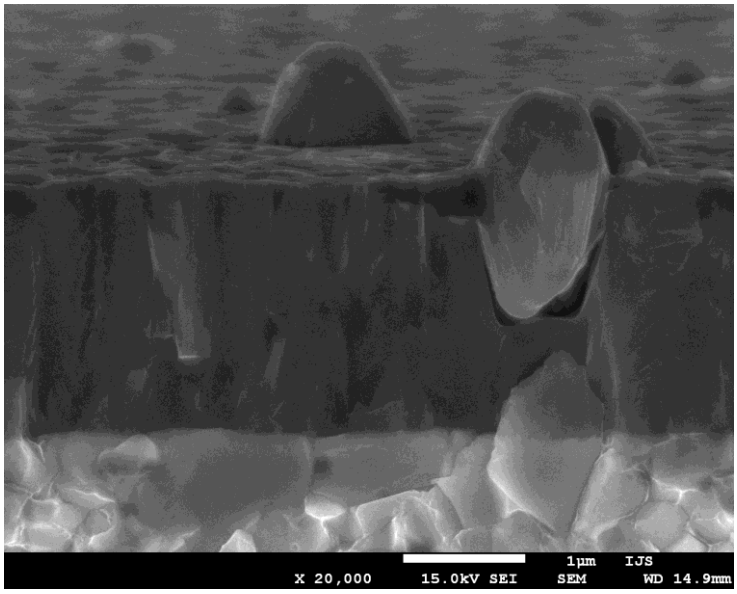

Figure 5: Growth defects embedded in a TiN coating, deposited by cathodic arc evaporation (Čekada M*, JSM 7600F*).

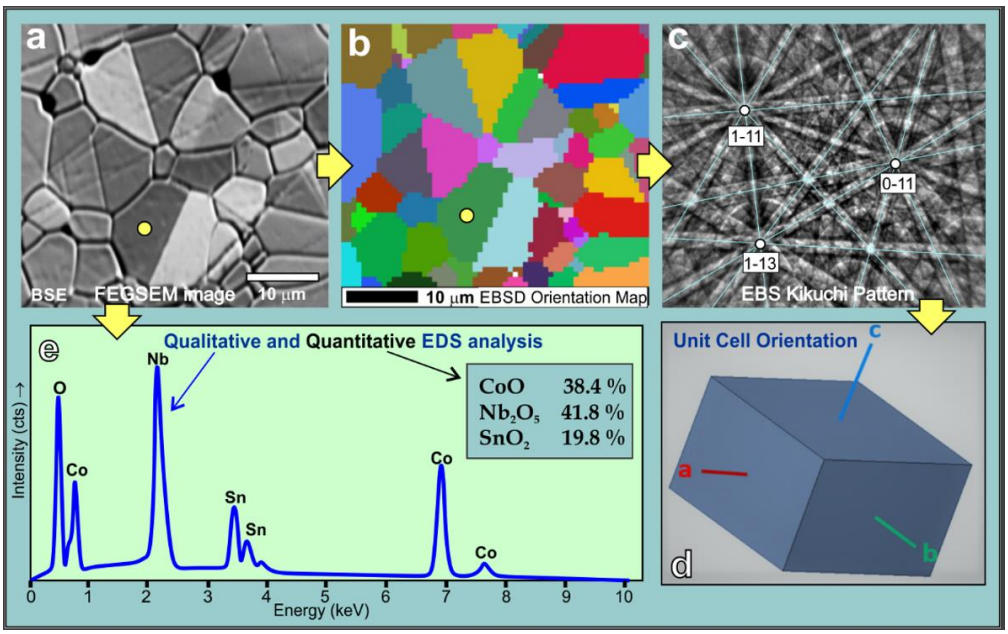

Figure 6: Correlative microscopy and microanalysis of SnO2-CoO-Nb2O5 ceramics: (a) FEGSEM BSE micrograph in compositional contrast mode showing the microstructure of ceramics, (b) corresponding EBSD orientation map reveals random crystallographic orientations of the grains, (c) individual EBSP Kikuchi pattern from selected grain (o), (d) reconstruction of orientation of tetragonal unit cell in selected grain, (e) EDS qualitative and quantitative analysis of chemical composition of the material (Samardžija Z, *JSM 7600F*).

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