

High-resolution 3D imaging of cement pastes – from the image acquisition to the estimation of material properties

Pavel Trtik

Empa, Swiss Federal Institute for Materials Science and Technology, Dübendorf, CH-8600,
Switzerland

pavel.trtik@empa.ch

Abstract

Recent development in the domain of microscopy techniques has enabled the high-resolution 3D imaging of complex, multiphase material microstructures (e.g. those of hardened cement pastes and other materials with inherent sub-microscale structural features). The available techniques for the high-resolution 3D images will be shortly presented and their advantages and disadvantages will be discussed. In particular, focussed ion beam nanotomography (FIB-nt), a locally destructive imaging technique based on the serial ion beam sectioning and the electron microscopy (see Figure 1), will be presented. Furthermore, the processes that may lead to the realistic segmentation of the 3D masks of the individual material phases will be discussed in detail. The use of such 3D masks of material phases for estimation of the local mechanical and other properties of the cement pastes will be included in the latter part of the lecture.

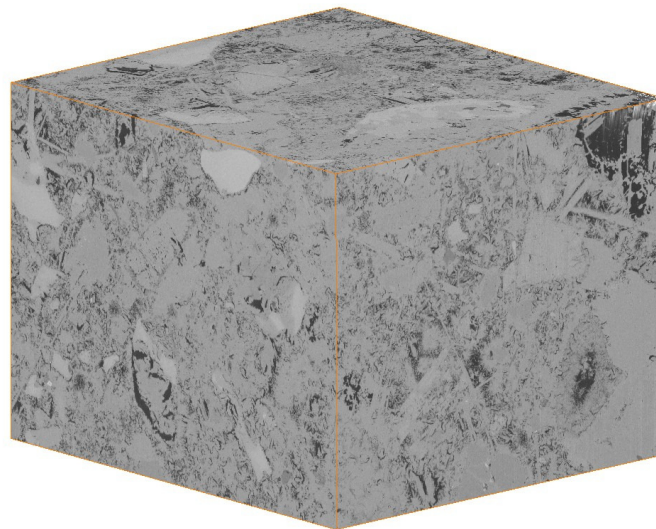


Figure 1 – Three-dimensional image of hardened Portland cement paste based on focussed ion beam nanotomography (FIB-nt). The images size is 1758 x 1326 x 1602 voxels; the isometric voxel size is 20 nm, leading to the corresponding size of the dataset of 35.2 x 26.5 x 32.0 μm^3 .