Composition and morphology of composite materials by ptychographic X-ray computed tomography

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The properties of functional composite materials are heavily affected by the arrangement of the different material phases within their 3D structure. The ability of visualizing their structures with high sensitivity and nanometric spatial resolution can improve the engineering of these composites. We show that ptychographic X-ray computed tomography (PXCT) is the key imaging technique to reconstruct quantitative 3D images of the complex-value refractive index of those heterogeneous materials in such a critical length scale[1-5]. Those 3D images can be processed later to extract the localization of the different material phases, the intermaterial pore space[1,2], and the composition of each constituent material of the composite without the need of spectroscopic measurements in certain cases[3,4]. At ESRF, PXCT is available at ID16A beamline. We present here the analysis of the structure of technical catalysts bodies for the oil industry at different lifetimes[1,2], the quantitative characterization of the hydration products of cement pastes[3,4], and the morphological structures of the interface metal-polymer aiming at improving the welding of metals for aerospace industry[5]. We will also quickly discuss the possibilities of the use of coherent beams at CRG beamlines of ESRF.

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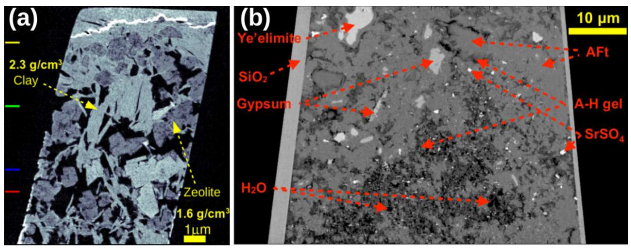

Figure 1: Examples of characterization of heterogeneous materials by PXCT: (a) Catalyst bodies for oil industry[1] and (b) hydrated eco-cement paste[4].