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Potential of spectral imaging in Micro-CT

Othmane Darouich[1,2], Kanchana Kularatne[1,3], Pascale Senechal[1], Hannelore Derluyn[1,3] David Barresi[2], Peter Moonen[1,3]

[1] Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, DMEX, Pau, France.

[2] Tescan France, Fuveau, France.

[3] Université de Pau et des Pays de l'Adour, E2S UPPA, CNRS, TotalEnergies, LFCR, Pau.

primary contact correspondence email: darouich.othmane@univ-pau.fr

Abstract

X-ray microtomography (micro-CT) is a powerful tool for the visualization and characterization of materials, allowing the analysis of the internal three-dimensional microstructure of samples in a non-destructive way. Voxelized images obtained by Micro-CT provide mainly morphological and topological information on the microstructure of the sample but remain limited in terms of chemical information. In contrast, analytical techniques such as energy dispersive spectroscopy coupled with scanning electron microscopy (SEM-EDS), Raman spectroscopy, SIMS, XPS etc., enable conducting detailed compositional analysis, but most of these are 2D surface characterisation techniques. Laboratory-based X-ray spectral micro-tomography (spectral-CT) is a new technique that can provide three-dimensional compositional information and identify the regions of interest for further analysis with complementary analytical techniques, hereby yielding a powerful workflow for material characterization.

In this study, we present the potential of spectral imaging in microtomography. This is achieved by combining spectral-CT with conventional Micro-CT. Complementary elemental and chemical analyses are performed using SEM-EDS. Through this approach, several materials from different research fields are analysed ranging from recycling (electronic devices), over electrochemical storage (batteries), up to geosciences (gabbro). The proposed approach has a promising future for three-dimensional chemical characterization of specimens in a wide range of applications.