Contribution ID: **160** Type: **poster**

Three-dimensional Percolation Properties Simulation of a Barrier Marine Coating Based on Its Real Structure from Ptychographic X-ray Tomography

Thursday, 19 September 2013 12:30 (2 hours)

Artificially structured coatings are widely employed to minimize materials deterioration and corrosion, the annual direct cost of which is over 3% of the gross domestic product (GDP) for industrial countries. Manufacturing higher performance anticorrosive coatings is one of the most efficient approaches to reduce this loss. However, three-dimensional (3D) structure of coatings, which determines their performance, has not been investigated in detail. Here we present a quantitative nano-scale analysis of the 3D spatial structure of an anticorrosive aluminium epoxy barrier marine coating obtained by ptychographic X-ray computed tomography (PXCT) [1-3]. From the analysis, orientations, lengths and volumes of individual objects in the coating film were revealed. We then use finite element simulations to demonstrate how percolation through this actual 3D structure impedes ion diffusion in the composite materials. We found the aluminium flakes align within 15 degrees of the coating surface in the material, causing the perpendicular diffusion resistance of the coating to be substantially higher than the pure epoxy [1]. The work demonstrated an approach for validating mechanistic assumptions of materials and potentially provides a practical method to engineer the efficacy of anti-corrosion coatings by modelling electrochemical process in materials based on the actual 3D structures.

(This abstract is based on the content from reference [1].)

[1] Chen, B. et al. Three-Dimensional Structure Analysis and Percolation Properties of a Barrier Marine Coating. Sci. Rep. 3, 1177 (2013).
[2] Dierolf, M. et al. Ptychographic X-ray computed tomography at the nanoscale. Nature 467, 436–439 (2010).
[3] Guizar-Sicairos, M. et al. Phase tomography from x-ray coherent diffractive imaging projections. Opt. Express 19, 21345–21357 (2011).

Primary author: Dr CHEN, Bo (London Centre for Nanotechnology, University College London)

Co-authors: Dr DIAZ, Ana (Paul Scherrer Institute); Dr BURGESS, Andrew (AkzoNobel (UK) Co. Ltd.); Dr VERGEER, Frank (AkzoNobel Co. Ltd.); Dr XIONG, Gang (London Centre for Nanotechnology, University College London); Prof. ROBINSON, Ian (London Centre for Nanotechnology, University College London); Mr NUTTER, John (London Centre for Nanotechnology, University College London); Ms SHEMILT, Laura (London Centre for Nanotechnology, University College London); Dr GUIZAR-SICAIROS, Manuel (Paul Scherrer Institute); Mr BURDET, Nicolas (London Centre for Nanotechnology, University College London); Dr HUO, Suguo (London Centre for Nanotechnology, University College London)

Presenter: Dr CHEN, Bo (London Centre for Nanotechnology, University College London)

Session Classification: Poster session II and lunch