PREPARATORY INDUSTRIAL PROJECT

Preparatory Study on Synchrotron InfraRed Imaging Characterization of Sustainable Coatings

THE INDUSTRIAL CHALLENGE

The European sheet steel industry is annually using 180 000 tonnes of paint for their coated products. The industrial challenge is to meet the market driven demand of increasing the content of "green carbons" in the paints, whilst maintaining the properties. The vision of the Swedish Steel company, SSAB, is to reduce the volumes of paints made from petroleum feedstock and strive to significantly increase the use of paint with high content of "green carbons" with less environmental impact. For example, by reducing the amount of volatile organic solvents in the paint in exchange for reactive diluents, made from natural oils.

Further development to increase the durability of the paint requires a deeper understanding of the bio-coating degradation. For instance, there is a need to gain a deeper knowledge of the local composition of a coating and degradation products on both a micro and nano level.

WHY USING A LARGE SCALE FACILITY?

Several laboratory-based techniques exist that provide complementary information regarding coating degradation. However, they all have limitations with respect to both time and length scales. The use of FTIR in combination with AFM (nanoIR) is a very promising technique for this application. This is due to its sensitivity to detect and study hydrolyses and photo-oxidation in a very local and small range.

The coupling of a synchrotron IR light source (SR-FTIR) would, however, enable the collection of IR spectra over a wide range, from the THz to near-IR range, with nanometric spatial resolution due to the broadband and intense synchrotron radiation. Compared to laboratory instruments using tunable lasers, synchrotron IR spectroscopy has several prominent advantages such as a wider spectral range, higher signal-to-noise ratio of spectra, a high accuracy of wavenumber, a short scan time and a very good spectra resolution.

The two dominant techniques for measuring IR spectra with nanometric resolution are scattering Scanning Nearfield Optical Microscopy (sSNOM) and Photothermal Induced Resonance (PTIR). sSNOM is based on detection of the light scattered from the near field and PTIR is based on photoacoustic detection using the AFM needle. Both techniques are available on different synchrotron facilities and have their respective advantages and disadvantages depending on type of test and what information that are desired.

THE RESULTS AND EXPECTED IMPACT

This mapping study identified facilities with the possibility to perform nanoIR and photothermal spectroscopy experiments.

Examples of identified synchrotron facilities capable of performing nanoIR experiments are Advanced Light Source (ALS) in USA, Brazilian Synchrotron Light Laboratory (LNLS) in Brazil, Soleil in France, Diamond in England and Metrology Light Source (MLS) in Germany. The setups that are considered suitable for our studies are those found at ALS in Berkeley, Soleil in Paris and MLS in Berlin.

We contacted experts at the Metrology Light Source (MLS) in Berlin to create opportunities for collaboration and engage in productive relationships with nanoIR experts at the PBT-laboratory.

We aim to use the MLS experimental station no 6, dedicated to infrared nano-spectroscopy (nano-FTIR) in the range of mid-IR.

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