

Non-Destructive Testing and Imaging of Marine Coatings using High-Resolution Mid-Infrared Optical Coherence Tomography

C. R. Petersen^{1,3}, C. Markos^{1,3}, N. M. Israelsen^{1,3}, P. J. Rodrigo², G. Woyessa¹, Peter Tidemand-Lichtenberg², C. Pedersen², O. Bang^{1,3,4}.

¹ DTU Fotonik, Technical University of Denmark, 2800 Kgs. Lyngby, Denmark

² DTU Fotonik, Technical University of Denmark, 4000 Roskilde, Denmark.

³ NORBLIS ApS, Virumgade 35D, 2830 Virum, Denmark,

⁴ NKT Photonics A/S, Blokken 84, 3460 Birkerød, Denmark.

Abstract

In the marine and offshore industry, protective coatings are essential to avoid corrosion and biofouling of marine vessels and structures. Corrosion eventually leads to structural degradation and biofouling increases the drag on ships, leading to increased fuel consumption. The lifetime and efficiency of a coating is ultimately reduced by the presence of coating defects, such as bubbles or poor adhesion. The number of defects is therefore an extremely critical quality parameter, but it is currently difficult to detect many of these defects, as they can be sub-mm and hidden below the surface. One way to image the subsurface structure of coatings in high resolution is using optical coherence tomography (OCT), which is a non-contact, non-destructive laser-scanning technique. Using a mid-infrared supercontinuum laser and a fast frequency upconversion detection system, it is possible to obtain subsurface images in real-time with a depth resolution of around 6-8 μm

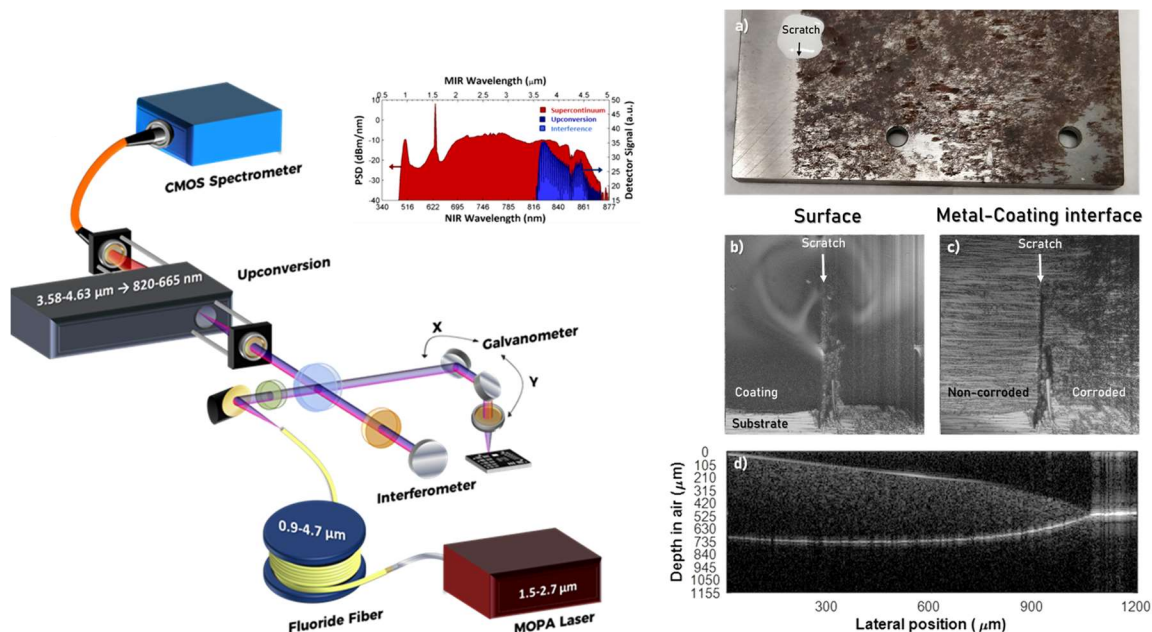


Figure 1. Left: Experimental configuration for the mid-infrared OCT system. The graph shows the supercontinuum laser spectrum (red) and the upconverted spectrum (blue). Right: Example of corrosion detection through 369 μm highly scattering corrosion resistant coating. (a) Photograph of the aluminium test plate. (b) Top-down OCT image of the coating surface near the scratch mark. (c) OCT image of the coating-substrate interface, showing visible corrosion on the right of the scratch. (d) Cross-section OCT image of the coating.