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3D Quantitative Damage Characterization in the Coating of a Metal Substrate with Terahertz Waves

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In this study, terahertz (THz) reflective imaging is applied to characterize damage in the coating on metal substrates. The coating was initially scratched, and after aging, different damage mechanisms have occurred. Since the coating is optically thin (compared to the wavelengths within the THz spectrum), the THz echoes will partially or totally overlap, which makes it difficult to reconstruct the damaged coating structure. THz frequency-wavelet domain deconvolution is applied to resolve the overlapping echoes. Based on the observed features in the deconvoluted THz signals, three types of damage, including corrosion, the appearance of blisters and delamination, are successfully identified. The corrosion area is located in the middle of the scratch, and the delamination occurs around the scratch. In the blister area, no delamination is observed, but the swelling of the coating is clearly revealed. Moreover, quantitative information in depth is also obtained by analyzing the deconvoluted data. The thickness of the delamination and the thickness of the coating in both the normal (undamaged) and blister areas can be calculated. 3D imaging results shown in Fig. 1 clearly exhibit the thickness distribution across the whole coating plane, which also highlights the features of the different damage mechanisms.

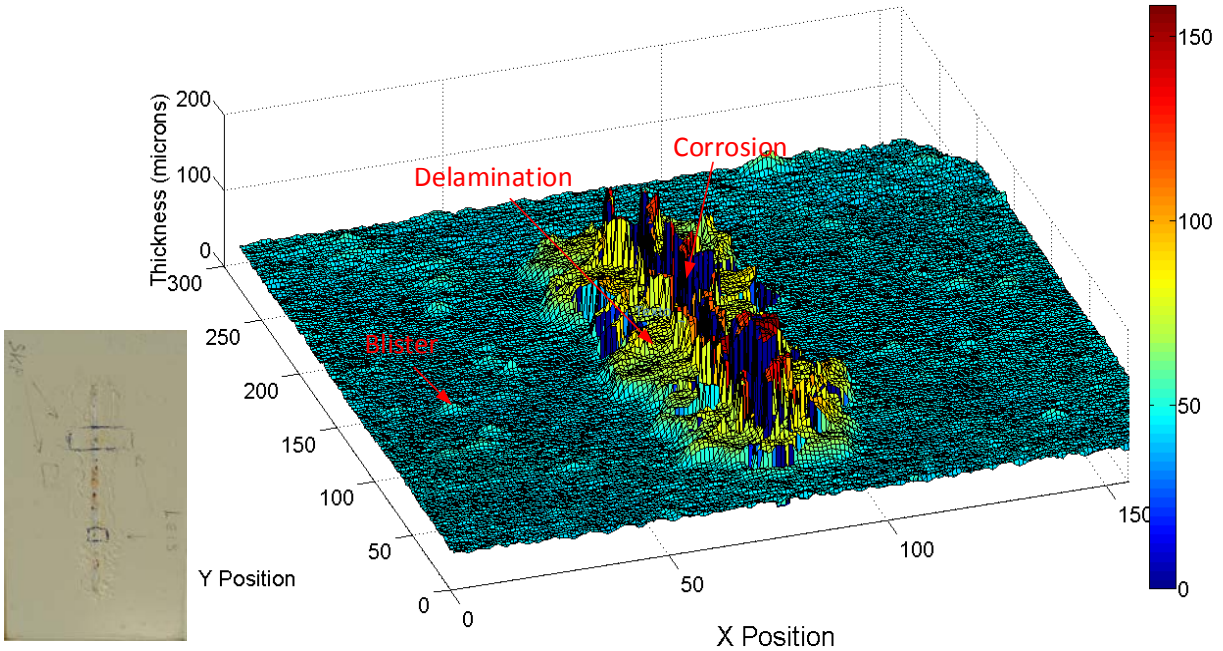

Figure. 1. THz 3D imaging of the thickness of the damaged coating. Different types of damage, including corrosion, delamination and blister areas are highlighted. The visible photograph of the sample is also shown for comparison.