Visualization of coating thickness applied on both sides of a steel plate by acoustic resonant imaging technique

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This study utilized the acoustic resonant imaging technique to visualize coating thickness applied to a steel plate on both sides in a two-dimensional manner. When sound passes thought a thin layer, the transmission and reflection coefficients of sound pressure reach their extreme values at the resonant frequency, and at this resonant frequency, one quarter wavelength of the sound corresponds to the thickness of the layer. This acoustic resonance is closely related to the physical properties and thickness of the layer, and the phenomenon has been widely used to characterize the layered media. In this study, polymer coating was applied to both sides of the steel plate, and this coating sample was placed in a water bath. The ultrasound was transmitted from the top surface of the sample, and the echo reflected from the back surface of the sample was recorded. In this transmission system, the echo transmittance of sound passing through the water/coating/plate interface takes its maximum value at the resonant frequency. On the other hand, the reflection coefficient of the sound reflected at the plate/coating/water interface takes its minimum value at the resonant frequency. Therefore, the frequency component of the echo reflected from the back surface of the sample includes information on the resonant frequencies occurring at both surfaces. Frequency analysis of the waveform data at each point recorded with the ultrasound image was performed to obtain the distribution of the resonant frequency for top coating and that for back coating. By using these distributions and the sound velocity of the coating determined in advance, it was possible to simultaneously visualize the thickness distribution of the coating on both surfaces of the plate. The present study has established the fundamental basis for a more intricate comprehension and accurate quantification of the thickness of coatings applied to steel plates.