

Sensitivity study between 633 nm and 1550 nm sensing LDVs on surface conditions of metallic structure using laser pulse-echo ultrasonic propagation imager

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Laser pulse-echo ultrasonic propagation imager (PE UPI) is novel non-contact non-destructive evaluation tool. PE UPI measures bulk wave in thickness direction in various ultrasonic modes generated by laser ultrasonic with Q-switched laser and sensing LDV. The PE UPI easily visualizes defect and damage through full-field bulk wave propagation based on pulse-echo ultrasonic wave propagation imaging (PE UWPI) video. Generally, 2 mW sensing LDV of 633 nm wavelength is used for inspection in the PE UPI, however, it is sensitive on various surface conditions. It means that the amount of reflected light from surface to the LDV is reduced because of surface roughness. It also influences quality of PE UWPI which is inspection result. Recently, 1550 nm wavelength infrared (IR) laser based LDV of 10 mW power has been used because longer wavelength and higher power improve the amount of reflected light to the LDV. Especially, the number of photon per unit power is relatively increased at longer wavelength thus it decreases noise in photodetector of the LDV. In this study, 633 and 1550 nm sensing LDVs in laser PE UPI are compared on various surface condition in manufactured process and various paint coating processes in metallic structure. Signal to noise ratio of 1D bulk wave ultrasonic signals on surface conditions was compared in the specimens of a machined carbon steel and a carbon steel which has various surface conditions with sanded raw surface, primer surface (undercoat) and three different thick paint surfaces (topcoat) including wall-thinning. In addition, sensitivity of PE UWPI is compared between 633 nm and 1550 nm sensing LDVs using PE UPI in the specimens.