Three-diemnsional photoacoustic SAFT imaging of subsurface and internal flaws in solid

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This study proposes a combined method of laser ultrasonics and array imaging. Here, we show two imaging methods for subsurface and internal flaws. One is for a subsurface flaw in a thin material such as carbon fiber-reinforced plastic (CFRP). This might be difficult to evaluate with conventional ultrasonic methods because of the interaction of the reflection wave at the surface and the scattered wave from the flaw. Here, we utilize ultrasonic waves generated at the surface of the CFRP by the photoacoustic effect of laser irradiations. The scattered waves are received by an ultrasonic array transducer at the same position where the laser is irradiated. The scattered waves are processed using the synthetic aperture focusing technique (SAFT), and the three-dimensional shape of the subsurface flaw is reconstructed. The other is for an internal flaw in solid such as stainless steel. In this case, the scattered waves are received by an array transducer at a different fixed place from the laser irradiation point and synthesized during the laser scan. We consider the group velocity distribution, which results from an anisotropy of the material in the calculation of the SAFT. We investigate the performance of each imaging by changing the laser irradiation condition and show the characteristics of these methods.