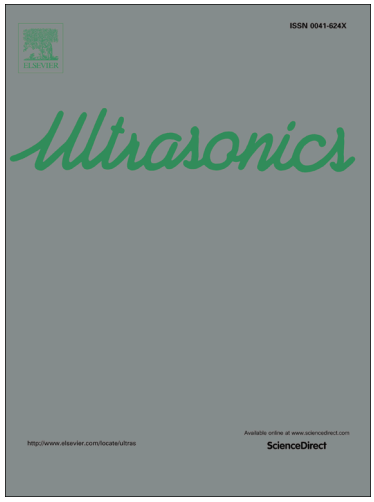

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Generation of narrowband elastic waves with a fiber laser and its application to the imaging of defects in a plate

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Abstract Pulsed laser equipment can be used to generate elastic waves through the instantaneous reaction of thermal expansion or ablation of the material; however, we cannot control the waveform generated by the laser in the same manner that we can when piezoelectric transducers are used as exciters. This study investigates the generation of narrowband tone-burst waves using a fiber laser of the type that is widely used in laser beam machining. Fiber lasers can emit laser pulses with a high repetition rate on the order of MHz, and the laser pulses can be modulated to a burst train by external signals. As a consequence of the burst laser emission, a narrowband tone-burst elastic wave is generated. We experimentally confirmed that the elastic waves agreed well with the modulation signals in time domain waveforms and their frequency spectra, and that waveforms can be controlled by the generation technique. We also apply the generation technique to defect imaging with a scanning laser source. In the experiments, with small laser emission energy, we were not able to obtain defect images from the signal amplitude due to low signal-to-noise ratio, whereas using frequency spectrum peaks of the tone-burst signals gave clear defect images, which indicates that the signal-to-noise ratio is improved in the frequency domain by using this technique for the generation of narrowband elastic waves. Moreover, even for defect imaging at a single receiving point, defect images were enhanced by taking an average of distributions of frequency spectrum peaks at different frequencies.