Interferometer of femtosecond laser-induced ultrasound at glass surface positions

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When a femtosecond laser beam is focused on a material, sound waves are generated through carrier generation by multiphoton absorption and electron-lattice interactions. The generated sound waves change dramatically depending on the object's state, making them suitable for measuring the structure and function of living organisms. In our laboratory, we have conducted experiments using microphones (10 Hz to 200 kHz) to measure sound waves and control the position of an objective lens for laser processing. We observed a change in sound pressure that decreased as the processing hole deepened. However, there was no change in the frequency spectrum between the sound waves generated on the sample's surface and the sound waves generated by the drilling of the processing hole. Therefore, we assumed that the sound caused by the small holes had a higher frequency. Consequently, we propose an ultrasonic system using optical interferometry to measure higher frequencies. This study employed a Linik interferometer with an objective lens for the sample and reference mirror. Ultrasonic waves generated during laser processing propagate in the object and on the surface. The sample surface where the ultrasonic waves reach vibrates with minute displacements. At the arrival point of the sound waves, a laser beam is irradiated to detect the sound waves, and the reflected object light interferes with the reference light. The microvibrations change the optical path length of the object light, which in turn changes the intensity of the interfering light, enabling the measurement of sound waves.

Short biography:

Sotaro Komatsu was born in 2000 in Ohtawra, Tochigi Prefecture. He graduated from Ohtawara High School in March 2019 and entered Utsunomiya University in April. In 2020, he moved on to the Information Electronics and Optics Course in the Faculty of Engineering. He is a member of Hayasaki Laboratory in Center for Optical Research and Education (CORE). His research field is optical metrology.