Lasers in Manufacturing Conference 2021

High speed temperature measurement in ultrashort pulse laser micromachining

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Abstract

Ultrashort pulse laser micromachining is affected by the heat accumulation resulting from the previous laser pulses. Up to now, most of the works analysed the accumulation by numerical modelling. The present work focussed on development of a temperature measurement system and its application directly during the process in nanosecond and microsecond time ranges. The measurement system was based on the infrared radiometry and a specific calibration was done in order to obtain temperatures from the measured signal. Micromachining of grooves was done using a picosecond laser with different pulse energies, repetition frequencies and scanning speeds. Obtained heat accumulation temperature ranged from 300°C to 2600°C. Surface roughness and ablation rate were determined by 3D confocal microscope. Good correlation was found between the roughness and the heat accumulation temperature, thus confirming the validity of calibration. Measured heat accumulation temperature was surprisingly the highest for the most efficient ablation parameters producing low roughness.

Keywords: Ultrashort pulse lasers; laser micromachining; process monitoring

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