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Review

Sensing and lasing applications of whispering gallery mode microresonators 180015

Yu Zheng, Zhifang Wu, Perry Ping Shum, Zhilin Xu, Gerd Keiser, Georges Humbert, Hailiang Zhang, Shuwen Zeng and Xuan Quyen Dinh

Optical whispering gallery mode (WGM) microresonators have attracted great attention due to their remarkable properties such as extremely high quality factor, small mode volume, tight confinement of modes, and strong evanescent field. All these properties of WGM microresonators have ensured their great potentials for applications, such as physical sensors, bio/chemical sensors and microlasers. Generally, the operational mechanism of sensors based on WGM microresonators is to monitor variations of WGM resonance wavelengths induced by physical changes of the system, and the ultrahigh Q factor and the strong evanescent waves make the variations of WGM resonances very sensitive to the surroundings. Moreover, since Garrett et al. demonstrated the first WGM lasers in 1961, WGM microresonators have been widely used in the field of microlasers because of the high Q factor and the small mode volumes. Due to these advantages, microlasers based on WGM microresonators can obtain an ultralow lasing threshold. This paper emphasizes the current state of the art of WGM sensors and mcirolasers, especially in terms of the sensing sensitivity and the pump threshold respectively. The key parameters and coupling conditions of WGM microresonators are discussed first. Then, some common geometries are presented based on their fabrication processes. Thirdly, the paper focuses on the recent progresses on applications of WGM microresonators in sensing and lasing fields. Finally, the future research trend is predicted in this field.

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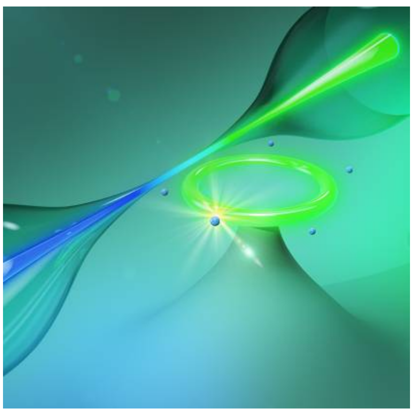

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Original Article

Acoustic wave detection of laser shock peening 180016

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Laser shock peening (LSP) is a new type of surface modification technology that can improve the fatigue life of materials by using laser-induced plasma shock waves. The research aiming at the phenomenon of plasma acoustic wave, an online LSP detection method based on acoustic wave signal energy is studied. The TiAl alloy samples were LSP treated by a Nd: YAG laser with a wavelength of 1064 nm, a pulse width of 9–21 ns and a signal pulse energy of 1–7 J. Laser is absorbed by the ablative layer on the surface of sample, and plasma of high temperature and pressure is formed under the tamping layer and propagated outward in the form of shock wave, which is also called plasma acoustic wave. The acoustic wave is sampled, stored, digitally filtered and analyzed by the online detection system, and the system gets the acoustic wave signal energy. The surface residual stresses of material after the treatment of LSP are measured by an X-ray stress analyzer. The experimental results show that the residual compressive stress is generated on the surface of material after the treatment of LSP. Both the surface residual stress and the acoustic wave signal energy increase as the laser pulse energy increases from 5 J to 7 J, and their growth trends are consistent. Finally, the empirical formula between the surface residual compressive stress of the material and the acoustic wave signal energy is obtained by polynomial fitting, which will provide a theoretical reference for the development of laser shock peening online detection technology.

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