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Development of the laser-induced water bubble actuator

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Abstract

Aiming to realize the newly actuator without any electric cable, the use of laser-induced water vaper bubble has been proposed and performed the principle confirmation experiment. The laser induced water bubble has been applied for the liquid jet therapeutic catheter in medical field. The liquid jet system use physiologic saline for the liquid and a Ho: YAG laser of 2.1μm wavelength that has highly absorption of water. Instead of this combination, we propose the use of carbon powder suspension for working liquid and an infrared Laser Diode (LD) of 970nm wavelength. As the 970nm LD light is not absorbed by water but carbon, the water of the working liquid could be vaporized by heated carbon. LD is considered as a suitable laser source for the actuator in the viewpoint of output controllability by the drive-current modulation. Figure 1 shows the conceptual image of the laser-induced water bubble actuator. It is constructed with a 970nm LD, an optical fiber and an actuator unit with working liquid for producing bubble. An optical fiber connector (SMA connector) has been used for the bubble generator unit in our principle confirmation experiment. We use the inlet space for inserting and fixing fiber cable as the actuator cylinder. The working liquid was prepared by suspending carbon powder of 20μm particle size in water with surface active agent. After the working liquid has been injected in the cylinder, a stainless steel rod of ⊠2.3mm diameter and 30mm length inserted as the actuator piston. When the laser irradiation was performed at the LD power of 160-180W and the pulse duration of 2msec, the reciprocating motions of the stainless steel rod have been observed. For the next step, we are planning to evaluate the operating characteristic and also try to maximize the generating force. This work was supported by JSPS KAKENHI Grant Number JP16K12914.

Biography

Shigeru Omori completed the Masters course from Graduate School of Electrical Engineering, Shibaura Institute of Technology in 1982. He joined Matsushita Denki Sangyo (c.k.a. Panasonic) in the same year. He was engaged in research and development of cathode ray tube and wavelength conversion device. He joined TERUMO Corporation in 1993. He was engaged in research and development of 3D television, micromachines, medical laser, and surgical manipulator at its R&D Center. He was a professor at Depart- ment of Medical Science, Faculty of Medical Science, Teikyo Heisei University in 2015. Presently, he is engaged in the development of medical laser and its application study. He is a Doctor of Medicine.

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