J Ind Electron Appl 2021, S10

Journal of electrical engineering and electronics technology

Short Communication

A SCITECHNOL JOURNAL

Laser excitation ultrasound in light absorbing liquids imputing laser radiation through optical fiber with colloidal coating of distal tip by a single layer of transparent spheres

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Abstract:

Efficient converters of optical laser radiation into high frequency acoustic for medicine and technologies are an important applied problem. A possible solution is to inject radiation into a liquid through the fiber, the distal end of which is covered by a layer of transparent microspheres. Microspheres act as lens here creating highly concentrated areas of light radiation in the liquid. In the presence of light absorption in the liquid, there arises a system of local heated volumes which leads to an optoacoustic (OA) response due to the thermoelastic effect. From this point of view, the layer of transparent microspheres at the distal tip of the fiber in a light absorbing medium can be considered to be a fiber laser–acoustic converter (LAC). Two opposite schemes of LAC are investigated experimentally in this report.

At first (a) we investigate ultrasound [1] excited by laser radiation through a quartz optical fiber Ø 1 mm with LAC — a coating at the distal tip of the fiber with Ø 0.96 µm polysterene (PS) spheres. The laser is YAG: Nd laser with λ = 1.064 µm, and distilled water is used as medium (light absorbtion coefficient α ≈ 0.1 cm-1). The laser generated in the zero transverse mode regime (beam diameter ≈2 mm) a train of pulses with a total duration of ≈300 ns with a spike frequency of ≈ 2 × 105 Hz using an optical passive modulator. This configuration of the experiment allows studying the basic parameters of the system in “primeval” form, avoiding the influence of more complex effects, such as thermal self-defocusing and superheated liquid states.

The second (b), opposite case is a use the coating of Ø 200 µm glass spheres on a glass substrate as the LAC in the laser beam (approx. Ø 1 mm) of second harmonic (λ = 0.532 µm) with impulse time 15 ns. The media is water - ink solution (α ≈ 100 cm-1) in this case [2].

Biography

Vladimir Bredikhin has completed his PhD in 1977 from University after N.I. Lobachevski in Nizhniy Novgorod (Russia) and Dr. Sc. (Phys.-Math.) in 2011 from Institute of General Physics after A.M. Prokhorov in Moscow (Russia). Now he is the Leading Scientist of Applied Physics of the Russian Academy of Sciences. He has published more than 100 papers in reputed journals and is been serving as an editorial board member and Associate Editor of Open Chemistry Journal (Bentham).

Publication of speakers

1. Vladimir I. Bredikhin and Viacheslav V. Kazakov. “The Excitation of Ultrasound by Laser Radiation in Water Using an Optical Fiber Laser Converter with a 2D Colloidal Crystalline Coating”, Coatings 2019, 9, 857, 1-9.
2. Vladislav Kamensky, Viacheslav Kazakov, Vladimir Bredikhin , Alexander Pikulin And Nikita Bityurin. “Use of Colloidal Monolayers of Glass Spheres for the Improvement of the Optoacoustic Ultrasound Generation”. Mater. Res. Express 2019 6 045201.

Citation: Bredikhin.V, Laser excitation ultrasound in light absorbing liquids imputing laser radiation through optical fiber with colloidal coating of distal tip by a single layer of transparent spheres, May 20-21, 2021, Osaka, Japan