

Ferroelectric liquid crystal as a coherent source of sound

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The new model of Sound Amplification by Stimulated Emission of Radiation (SASER) is presented. This model represents SASER as a rectangular resonator filled with a ferroelectric liquid crystal. The comparative analysis of the offered models with SASER schemes based on gas-liquid mixtures is carried out. The advantage of the developed model as compared to the analogues proposed before is discussed.

Предложена новая модель сазера (SASER — Sound Amplification by Stimulated Emission of Radiation), которая представляет сазер как прямоугольный резонатор, заполненный сегнетоэлектрическим жидким кристаллом. Проведен анализ известных схем сазеров, использующих жидкостно-газовые смеси. Обсуждаются преимущества предложенной схемы по сравнению с известными.

Now there are a variety of laser types — devices generating coherent electromagnetic radiation. There is a wide choice of lasers working in various ranges of wavelengths (from ultra-violet up to submillimetric). The theoretical circuits of the acoustic analogue of the laser were offered recently [1, 2]. However these circuits were not realized practically. It is necessary to solve a number of scientific problems before "the acoustic laser" will be elaborated. Coherent source of sound is of great interest for the world economy because of an opportunity of the wide application of such devices. New branch of physical science, viz., coherent acoustics, can be grounded on the discovered regularities. The "acoustic laser", designed to operate in the 20–50 kHz range, can be used in development of advanced device technologies for medical diagnostics, for defectoscopy, for application in sonochemical processes and in scientific investigations. The narrow beam SASER will allow to increased accuracy of sonar. The problem of the acoustic analogue of known laser systems has not been considered until now. Now we can discuss only about the physics

of processes, corresponding to the coherent emission of acoustic waves.

According to our point of view, the basic problem of SASER creation is the choice of active medium. The most known of theoretical models of SASER proposing a mixture of gas and liquid as active medium have not been realized yet because of the difficulties associated with the sound excitation and the achievement of the autosynchronization. As active medium, it is usually offered to use liquid dielectric with dispersed particles. Each dispersed particle is the mechanical oscillator. Coherent addition of sound waves from each oscillator it is necessary for occurrence of the sound generation. The synchronization of system of noncoherent mechanical oscillators was considered for mixture of gas and liquid [3]. Sound vibrations in the Helmholtz resonator, filled with the oversaturated vapour, were investigated [4]. As the condensation exceeds the evaporation, the energy of system is released and partly absorbed with the acoustic vibration. However these circuits were not put into practice. The achievement of the synchronization condition is the most difficult prob-