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Concept of equivalent temperature of laser crystals and glasses

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One of the main factors that characterizes crystal quality, is overheating induced by interaction with laser radiation. Nonuniformity of crystal temperature distribution is a condition by the intensity distribution of propagating laser radiation. In this case, a conventional approach using thermodynamic temperature for the characterization of crystal heating is incorrect. Recently, we have introduced novel notion of equivalent temperature of nonlinear-optical crystals interacting with laser radiation. All nonlinear-optical crystals possess piezoelectric properties. Value of the crystal equivalent temperature is determined directly by measuring a frequency shift of the crystal eigenmodes, which are noncontactly excited by application of the probe radiofrequency electric field. This approach was successfully applied for the investigation of massive lithium triborate (LBO) crystal boules. It is necessary to take into account the presence of the considerable temperature gradient inside the large-size crystals when investigating its interaction with laser radiation. Here, for the determination of the optical absorption coefficient, it is not sufficient to know the equivalent temperature measured using certain resonance of the sample, because an additional information such as the surface temperature is necessary. For this purpose, it is proposed to use the tiny microresonators made of piezoelectric crystals, which resonance frequencies are strongly temperature sensitive. Microresonators should exhibit both high heat conductivity and low optical absorption at involved radiation wavelengths. When the microresonator is placed onto the crystal boule, its temperature can be identified with the temperature of the corresponding area of the boule surface. During the laser irradiation, the kinetics of both the equivalent volume temperature of the boule and the temperature distribution at its surface were measured. Then the absorption coefficient of the boule was calculated by solving the nonstationary heat conduction equation taking into account the heat transfer change with both environment temperature and the surface temperature of the crystal.

Biography

Aleksei Koniashkin completed his PhD from Kotelnikov Institute of Radio Engineering and Electronics of RAS. He is the Senior Scientist at the Kotelnikov Institute of Radio Engineering and Electronics of RAS. He has published more than 15 papers in reputed journals.

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