Measurement of optical absorption coefficients of nonlinear-optical materials using piezoelectric crystal oscillator circuits

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Nonlinear conversion of laser radiation frequency in nonlinear-optical crystals is an efficient way to obtain laser generation at new wavelengths. It is essential that conversion efficiency is governed by phase matching conditions between interacting electromagnetic waves. Crystals applied in nonlinear optics usually have low optical absorption coefficients in operating range. However, in the case of high power radiation even low absorption can lead to significant nonuniform heating of crystals and violation of phase matching conditions. Determination of optical absorption coefficients of nonlinear-optical crystals as well as measurement and control of its temperature during laser irradiation is an important task. For this purpose we propose to exploit temperature sensitive piezoelectric resonances of crystals, which can be excited noncontactly using probe radiofrequency electric field. Piezoelectric resonance frequency is measured using the crystal as a frequency selective filter in a feedback loop of the generator (e.g. Pierce electronic oscillator). Therefore, when the crystal is heated by laser radiation its temperature kinetics can be directly obtained by measuring the oscilation frequency change. Optical absorption coefficient is determined by finding the correspondence between the solution of the nonstationary heat conduction equation and measured temperature kinetics.