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The photodielectric response of ZnSe crystals in a quadrupolar variable electric field

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Effect of uniform and non-uniform variable electric field on spectral dependences of stress-strained ZnSe crystals has been studied. The spectral dependences of the complex photocapacity $C^*(\lambda)$ measured in a quadrupolar variable electric field for ZnSe crystals containing regions with various scale plastic deformation levels have been shown to differ considerably from those of the complex dielectric constant. These distinctions reflect the rearrangement of interconnected internal elastic and electric fields due to the external quadrupolar one. The $C^*(\lambda)$ diagrams allow to identify the crystals having similar energy and relaxation spectra.

Исследовано влияние однородного и неоднородного переменного электрического поля на спектральные зависимости фотодиэлектрического отклика кристаллов ZnSe, выращенных из расплава и отличающихся напряженно-деформированным состоянием. Показано, что в кристаллах ZnSe, содержащих области с различным масштабным уровнем пластической деформации, спектральные зависимости комплексной фотоемкости $C^*(\lambda)$, измеренные в квадрупольном переменном электрическом поле, существенно отличаются от спектральных зависимостей комплексной диэлектрической проницаемости. Эти различия отражают перестройку взаимосвязанных внутренних упругого и электрического полей под воздействием внешнего квадрупольного поля. Представленные в виде диаграмм $C^*(\lambda)$ они позволяют идентифицировать кристаллы с близкими энергетическим и релаксационными спектрами.

A wide variety of bidimensional (2D) structure defects forming spatially non-uniform elastic and electric fields is typical of bulk piezoelectric ZnSe crystals grown from the melt. The character and level of those fields defines the specific features of the intrinsic elastic vibration spectrum [1] and causes distinctions in the spectral dependences of real, $\varepsilon'(\lambda)$, and imaginary, $\varepsilon''(\lambda)$, parts of the complex dielectric constant ε^* measured in an uniform electric field. For crystals containing 2D defects (rotative twins, sliding bands, etc.), those dependences presented as $\varepsilon^*(\lambda)$ diagrams on the complex plane reflect the effect of spatially non-uniform internal fields on the energy spectrum of centers responsible for photosensitivity [2, 3]. The purpose of this work is to study the influence of a quadrupolar electric field forming torsion stresses in a piezoelectric crystal on the complex photocapacity C^* for zinc selenide crystals being in a stress-strained state.

The bulk ZnSe crystals (up to 50 mm in dia.) were grown from the melt using the Bridgman technique under Ar atmosphere. The growth conditions provided formation of cylindrical ingots differing from each other in the type and number of structure defects (dislocations, twins, sliding bands, etc.). From those ingots, samples were made shaped as cubes with 8–10 mm side and rectangular plates ($5\times5\times10$ mm^3) which were polished by machining and chemical treatment. Indium-gallium contacts were applied onto opposite faces of oriented samples. The