

Optical and EPR study of Cr-doped β -Ga_{2-x}In_xO₃ solid solutions

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Optical absorption, luminescence and EPR spectra of single crystals of Cr-doped β -Ga₂O₃ and β -Ga_{2-x}In_xO₃ solid solutions have been investigated. In the investigated samples, red luminescence typical of Cr³⁺ and intrinsic UV-blue luminescence were observed. The results obtained have shown that chromium is incorporated in all samples of β -Ga₂O₃ and β -Ga_{2-x}In_xO₃ solid solutions only as Cr³⁺ (3d³) ions occupying octahedral sites. EPR spectra of Cr³⁺ ions in β -Ga_{2-x}In_xO₃ solid solutions are characterized by inhomogeneous broadening of spectral lines caused by different local environment and statistical distribution of crystal field parameters. Influence of different annealing modes and structural disordering on the Cr³⁺ and intrinsic luminescence in the Cr-doped β -Ga₂O₃ crystals and β -Ga_{2-x}In_xO₃ solid solutions are discussed.

Исследованы спектры оптического поглощения, люминесценции и ЭПР монокристаллических образцов β -Ga₂O₃ и твердых растворов β -Ga_{2-x}In_xO₃, легированных Cr. В исследованных образцах наблюдается типичная для Cr³⁺ красная люминесценция и собственная УФ-голубая люминесценция. Полученные результаты показали, что Cr вошел во всех образцах β -Ga₂O₃ и β -Ga_{2-x}In_xO₃ исключительно как ион Cr³⁺(3d³) и занял октаэдрические узлы. ЭПР спектры ионов Cr³⁺ в твердых растворах β -Ga_{2-x}In_xO₃ характеризуются неоднородным расширением спектральных линий, что обусловлено различиями в локальном окружении и статистическим распределением параметров кристаллического поля. Обсуждается влияние различных видов термообработки и структурной неупорядоченности на собственную люминесценцию и люминесценцию Cr³⁺ в кристаллах β -Ga₂O₃ и твердых растворах β -Ga_{2-x}In_xO₃, легированных Cr.

Compounds of complex Ga-containing oxides in the form of single crystals and thin-film structures are used both as active elements in the modern electron devices and transparent conducting coatings. Depending on the synthesis conditions and dopant type, these materials exhibit effective luminescence and photosensitivity and can be used for production of lasers, ionizing radiation sensors, and other devices. This is

true also for Cr-doped binary Ga-containing crystalline compounds: β -Ga₂O₃ single crystals and β -Ga_{2-x}In_xO₃ solid solutions. For practical applications, the role of impurities and intrinsic lattice defects in formation of luminescence, traps and recombination centers in these new materials should be elucidated.

Modern optical and EPR spectroscopy methods are effective means to study the nature, local environment, and crystal field