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# Luminescence and photoconductivity features of gallium garnet crystals

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The photoconductivity and luminescence spectra of garnet crystals $A_3B_2Ga_3O_{12}$ (where $A = R^{3+}$ — Nd, Sm, or Gd; B = Ga or Sc) have been studied in 200 to 400 nm UV region at temperatures of 80 to 295 K. A special attention is given to separation of contributions of various origins to relaxation of excitations being realized in emissive and non-radiative ways (in the last case, the process occurs with photoinduced charge transfer). Comparison of the narrow photosensitivity and luminescence bands with corresponding excited states and the energy level diagram of free $R^{3+}$ ions makes it possible to identify the line peaks as interlevel electron transitions within the $4f$ shell of the ions. The $^6H_{7/2} \rightarrow {}^6P_{7/2}$ transition in $Gd^{3+}$ ion being a probable one in the gadolinium garnets is supposed to be responsible for the narrow luminescence band at about 382 nm. The probable mechanisms of the observed UV luminescence and photoconductivity are discussed briefly.

Исследование спектров фотопроводимости и люминесценции кристаллов гранатов состава $A_3B_2Ga_3O_{12}$ (A = $R^{3+}$ — Nd, Sm, Gd; B — Ga или Sc) проведено в ультрафиолетовой области 200–400 нм при температурах 80–295 К. В работе уделяется внимание выделению вкладов различной природы в процессы релаксации возбуждений излучательным и безызлучательным с фотоиндуцированным переносом заряда путями. Сопоставление узких полос фоточувствительности и люминесценции с соответствующими возбужденными состояниями и схемы энергетических уровней свободных ионов $R^{3+}$ дает возможность идентифицировать линейчатые пики как электронные переходы между уровнями $4f$-оболочки этих ионов. Предполагается, что переход $^6H_{7/2} \rightarrow {}^6P_{7/2}$ иона $Gd^{3+}$, как вероятный в гадолиниевых гранатах, может отвечать за узкую полосу люминесценции ~382 нм. Коротко рассматриваются возможные механизмы наблюдаемых ультрафиолетовой люминесценции и фотопроводимости.

Our research team studies comprehensively [1–4] the relaxation processes of excitations (at energy values exceeding 3 to 5 eV) in rare-earth (RE) gallium garnet (GG) crystals of $A_3B_2Ga_3O_{12}$ (where $A = R^{3+}$, a RE ion; B = Ga or Sc) composition at the emission stage or that of competing non-radiative photoinduced charge transfer. There is no unambiguous explanation of the phenomena observed. In particular, to understand the free charge carrier generation mechanism under excitation in $4f^n$ absorption bands of RE ions in UV region ($f$-photoconductivity [2]), as well as the UV luminescence nature in the crystals mentioned above [3], comprehensive experimental data and their profound analysis are required. Research works in this field are stimulated by the wide practical application or the application prospects of the above-mentioned garnets in modern science and engineering branches such as quantum electronics, high energy physics, etc. Moreover, we have proposed [1, 4] to use the compounds under study as photosensitive materials in selective and wide-band detectors for UV region. Such detectors are intended to be operated in the photo-electret state [1, 4]. The REGG crystals draw an attention also as scintillation materials of promise with ultra-short afterglow times [3].

The non-elementary character of REGG emission and photoconductivity (PC) in the UV region is a characteristic feature of