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X-ray luminescence of PWO crystals with stored light sum

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Undoped $PbWO_4$ crystals have been investigated to study the structure of centers responsible for the excitation energy accumulation and transformation. Temperature dependences of X-ray luminescence intensity and thermostimulated luminescence curves have been obtained within 90 to 350 K temperature range. The centers of excitation energy accumulation and transformation (A–T centers) have been shown to exist in PWO. An A–T center includes an emission one and electron traps related together due to pair recombination interaction. The part played by the rest of the crystal volume seems to be reduced to the energy absorption and the free charge carrier generation.

Исследовались нелегированные монокристаллы $PbWO_4$ с целью изучения строения центров, ответственных за накопление и трансформацию энергии возбуждения. Получены температурные зависимости интенсивности рентгенолюминесценции и кривые термостимулированной люминесценции в температурном интервале 90–350 К. Показано, что в PWO существуют центры аккумулирования и трансформации энергии возбуждения (А–Т-центры). В состав А–Т центра входит центр свечения и электронные ловушки, связанные парным рекомбинационным взаимодействием. Роль остального объема кристалла сводится к поглощению энергии и генерации свободных носителей заряда.

Investigations in luminescence properties of lead tungstate ($PbWO_4$, PWO) are stimulated in the last years by intense research development in high-energy physics (the CMS experiment at CERN). Although the properties of that crystal are under study for a rather long time, some problems of importance remain still unsolved to date, including those concerning the storage and recombination center structures as well as the energy transfer mechanisms from one centers to other.

In this work, the X-ray luminescence (XRL) of undoped PWO crystals with accumulated light sum has been studied using the double excitation method. The work purpose is to study the structure of centers responsible for the energy storage and transformation. The method used makes it possible to observe the XRL temperature dependence and simultaneously the thermoluminescence (TL), thus allowing to study the corresponding processes in their dynamics. The sample irradiation at a low temperature results in the light sum accumulation. Then it is heated linearly under simultaneous excitation by light or X-rays and the temperature dependence of the emission intensity is recorded. In the region of the accumulated light sum glow, a periodical short-time excitation is used, thus, the signal being measured is either the total XRL and TL intensity or only TL one. This makes it possible to observe separately the temperature dependent behavior of both emission components. The TL excitation was selected so that both XRL and TL intensi-