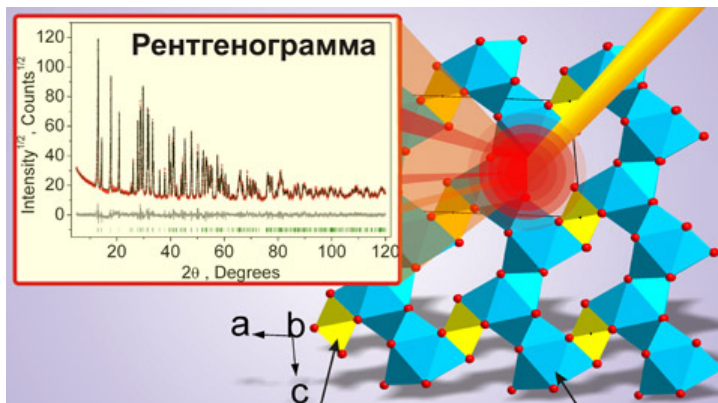


A Russian Physicist Described the Structure and Properties of a Prospective Luminescent Substance

A physicist from Siberian Federal University (SFU) and Kirensky Institute of Physics Federal Research Center KSC SB RAS (IF) described the structure and properties of a new substance obtained by his Chinese colleagues. These are layered crystals of rare earth metal hydroxides $\text{Ln}_2(\text{OH})_4\text{SO}_4$ ($\text{Ln}=\text{Eu}-\text{Lu}, \text{Y}$) that may act as eco-friendly sources of phosphors (substances that transform different energies into emission of light) for panels, screens, and other electronic devices. The discovery was [reported](#) by Chemistry: A European Journal.



As usual, the discovery happened by chance. Chinese researchers synthesized a new powder substance mixing rare earth metal nitrates with ammonia sulfates and hydrates. The compound contained rare earth elements and therefore had luminescent properties. However, its spectrum was unique and not consistent with any expected result. Scientists were surprised to learn that its X-ray pattern was not comparable to any other one from their database. Therefore, the substance not only had new composition, but belonged to a whole new class of compounds.

First of all, the researchers had to characterize the substance's crystal structure, i.e. to determine the atoms it consists of and their location relative to each other.

“What was difficult about it is that we were unable to obtain the substance in the form of a monocystal, therefore standard single-crystal X-ray methods could not be used. Determining structure from powder is a very complicated task that requires vast experience and knowledge,” said **Maksim Molokeev**, a co-author of the work, candidate of physical and mathematical sciences, senior researcher of Kirensky Institute of Physics, and a senior tutor at SibFU.



This was the very task that Chinese scientists asked Maksim Molokeev to solve. He managed to successfully decode the X-ray pattern of the powder. It turned out that the new material consisted of SO_4^{2-} tetrahedra and ions of rare earth elements surrounded by atoms of oxygen in the form of a three-capped trigonal prism. The SO_4^{2-} tetrahedra were disordered in several positions, i.e. these structural elements constantly changed their orientation in space and time (making the interpretation of the structure even more difficult).

After the structure of this layered compound was determined, it confirmed its unique nature. The substance was really a part of a new previously unknown class. Moreover, the researchers found out that the compound had very rare and valuable properties. When it is heated to 800 °C, water is evaporated leaving phosphor that can be used on the industrial scale (e.g. in screens). Traditional production methods are “dirty” and cause emissions of toxic by-products. The new substance helps achieve the desired results in an eco-friendly way.

In the future new iso-structural compounds (i.e. the compounds in which ions are replaced with different ones without material structural changes) are likely to be added to this class of substances. These new compounds may be used in the manufacturing of catalysts, microelectronics, UV protection, and other prospective scientific and technical areas.

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