THE INFLUENCE OF DIRECT ELECTRIC CURRENT ON THE PROPERTIES OF $CsPbCl_3$ AND $CsPbBr_3$ PEROVSKITES

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Introduction

Nowadays silicon-based solar cells are mainly used in solar power. The efficiency of cells does not reach 0.25. Therefore, the search for effective and inexpensive materials for solar cells remains relevant. Recently, the attention of researchers was drawn to organo-inorganic perovskites with the general formula $MPbX_3$. A factor of conversion of solar energy into electrical at the level of 0.22 was obtained for these crystals in the laboratory. However, these elements degrade very quickly. Therefore, the attention of the researchers was drawn to completely inorganic perovskites, where cations are cesium ions.

Methods

$CsPbCl_3$ and $CsPbBr_3$ single crystals grown by the Bridgman method were used for the studies.

To identify the crystal structure and to change it as a result of coloring the crystals, X-diffraction studies of the original and colored samples were performed.

Results and Discussion

The obtained samples were characterized by a fairly high transparency in the visible region of the spectrum and had a clear intrinsic absorption edge in the region of about 420 nm. When an electric current passes through the sample, its transparency in the visible region of the spectrum decreases (the crystal turns colored), especially in the wavelength range of 430 nm. In Fig. 1, it is shown the transmission spectra of experimental samples once a direct electric current passed through them.

The samples were subjected to electric shock (several microamperes) at different direct voltages (300 V, 400 V, 500 V).

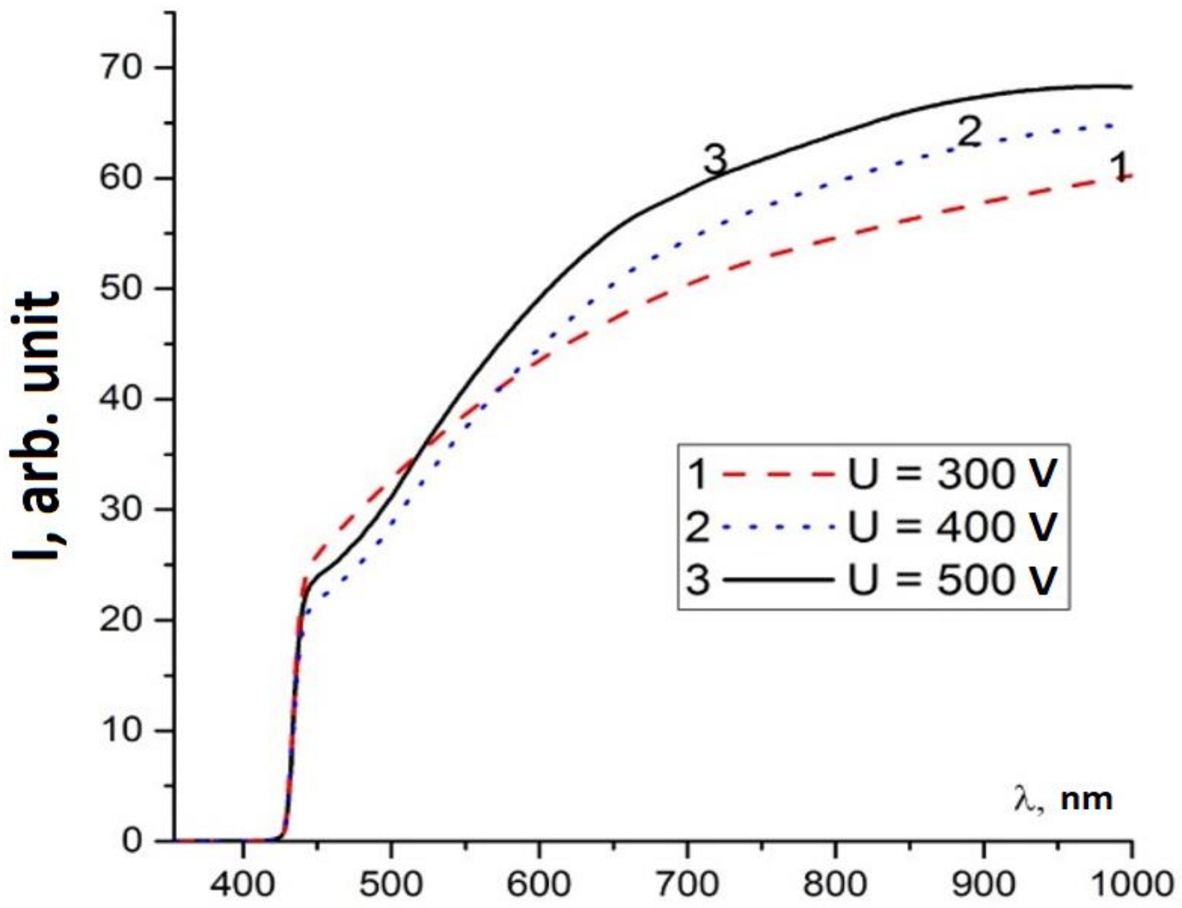

Fig. 1 – Transmission spectra of the $CsPbCl_3$ crystal

After the previous action of the electric field and sunlight on the crystal, color centers appear in it. When an electric field is applied for t = 90 min, no individual absorption bands are observed. However, an increase in intensity occurs in the entire spectral region. The intrinsic absorption edge is observed, which is located at λ = 430 nm.

Conclusions

As the current passes as a result of moving the anions, the crystal is not colored uniformly throughout the volume but becomes darker (more colored) near the negative contact. This means that from this area the anions move to the positive contact, and a region of the crystal emerges, which is depleted by the anions. After the effect of direct electric current, the lead caused strong absorption in the visible region of the spectrum, which was observed on the optical transmission spectra.