IMPEDANCE SPECTROSCOPY OF SINGLE CRYSTALS $CsPbBr_3$

Lys R.M., Tymkiv Yu.V., Slobodzyan D.P.

Department of Sensor and Semiconductor Electronics,
Ivan Franko National University of Lviv.
Str. Tarnavskoho, 107, Lviv-79017, Ukraine.
E-mail: y.tymkiv.official@gmail.com

11th International Conference
"Nanotechnologies and Nanomaterials"
NANO-2023

Will be held
16-19 August 2023
in Bukovel

Introduction

Impedance spectroscopy is one of the modern methods of studying the conductivity of materials, which allows us to understand their electrical properties and behavior in various conditions.

Lead-based perovskite single crystals, in particular lead bromide $CsPbBr_3$, are of particular interest due to their good photovoltaic characteristics and thermal and moisture resistance. In this study, we use AC impedance spectroscopy to analyze $CsPbBr_3$ single crystals and study their conductivity.

Methods

Impedance spectra were recorded using an automated system based on a Hioki IM3536 LCR meter. Alternating current impedance spectroscopy was performed on single crystals of $CsPbBr_3$ perovskites.

The simulation model of the equivalent circuit of alternating current impedance spectroscopy was chosen.

Results and discussion

It is shown that the experimental samples have mixed ion-electron conductivity. Lead-based perovskite (lead bromide $CsPbBr_3$) has good photovoltaic properties and is also heat- and moisture-resistant. This makes him a good candidate as material for solar cells.

Semicircles on Nyquist diagrams (closer to the origin) are explained by the process in which electrons (or ions) vibrate around equilibrium positions. The diameter of the semicircles is equal to the resistance, which characterizes the opposition to the movement of electrons (or ions) in the lattice. Inclined lines at low frequencies refer to the impedance that occurs during mass transfer during ion diffusion. When these lines disappear, it indicates that electronic conductivity dominates over ionic conductivity.

R - the electronic component of the resistance. Q_1 and Q_2 - a permanent phase element.

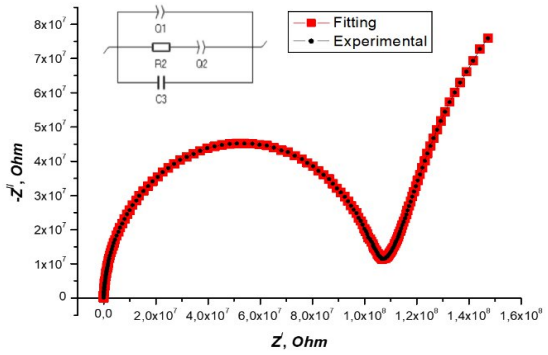

Fig. 1 – The experimental and fitting data for $CsPbBr_3$ impedance spectra.

Conclusions

As a result of the impedance-spectroscopy study of $CsPbBr_3$ single crystals, mixed ion-electron conductivity was found in the studied samples. This confirms the prospects of using $CsPbBr_3$ as a material for solar cells and other technological applications, due to its photovoltaic properties and resistance to the influence of external factors.