

Stability of the cubic phase in CsSnCl₃ perovskite maintained under different humidity and luminosity conditions

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INTRODUCTION

The perovskite CsSnCl₃ has various potential applications, including its potential use in photocatalysis tests, LEDs, solar cells, photodetectors, and photovoltaics, due to its bandgap values ranging from 2.8 to 3.8 eV. However, its low structural and chemical stability has limited its use. Ziyang Wu et al.¹ observed that this type of material undergoes physicochemical changes within a few days under moisture and light conditions, leading to the loss of its photocatalytic activity and thus limiting its intended applications. DSC analysis indicates that only the cubic phase is formed in CsSnCl₃ systems above 110°C, a phase that presents bandgap values applicable for use in solar cells. However, through a route developed by us, it was shown that at this temperature, the synthesis process involves the coexistence of cubic and monoclinic phases (30 wt.% and 70 wt.%, respectively).

EXPERIMENTAL/THEORETICAL STUDY

The synthesis process of CSSNCL₃ nanoparticle consists of mixing the salts in the desired stoichiometric proportion and adding water. After that, take in preheated oven at 150 degrees for 1 hour. The whole process is done without atmosphere control, making the method fast and easily scalable.

The new nanoparticles were characterized by XRD, TEM and spectroscopy UV-VIS.

RESULTS AND DISCUSSION

The process produced CsSnCl₃ nanoparticles with a coexistence of phases monoclinic and cubic perovskite (60 -30 wt.%) in a spherical shape. The TEM measurements showed the spherical format and the size distribution particle exhibit a mean diameter of 15 nm. This material was studied along the months and the cubic phase remains after 1 month. The monoclinic phase still is stable after 12 months without atmosphere control.

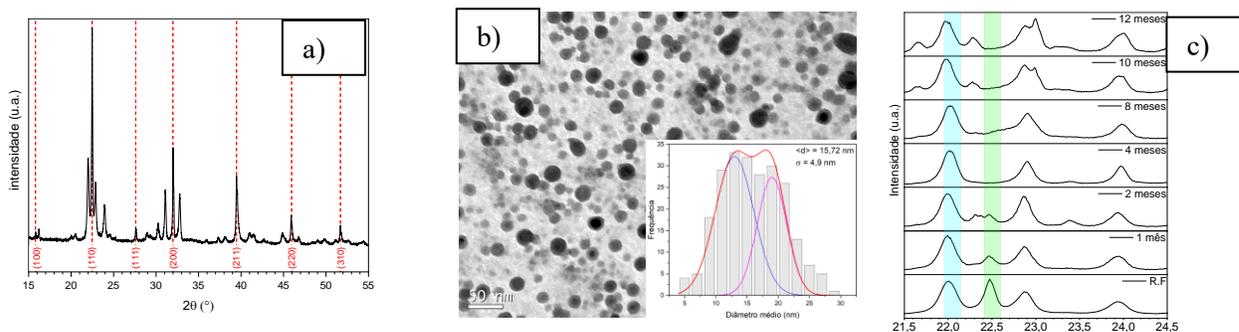


Fig. a) XRD of CsSnCl₃ NP using a novel route. Peaks in red are corresponding of cubic perovskite. All the others peaks are corresponding through monoclinic phase. B) TEM image of as prepared NP. Insert corresponding the size distribution. C) Study of Np through the time without atmosphere control.

CONCLUSION

The synthesis process involves the coexistence of cubic and monoclinic phases (30 wt.% and 70 wt.%, respectively). By transmission electron microscopy, the nanoparticles showed an average particle size variation from 60 to 100 nm in a spherical shape. Bandgap values were obtained through UV-Vis spectroscopy and ranged between 2.8 and 3.2 eV. The results obtained offer a new option regarding the stability of inorganic perovskites under ambient conditions of light and humidity. The next steps are producing a new type of solar cell that can use this material as a active layer or as a transport layer (ETL or HTL).

REFERENCES

1. WU, Ziyang et al. Stabilizing the CsSnCl₃ perovskite lattice by B-site substitution for enhanced light emission. Chemistry of Materials, v. 31, n. 14, p. 4999-5004, 2019

ACKNOWLEDGMENTS

This study was financed in part by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior-Brasil (CAPES)-Finance Code.