XXI Brazilian Meeting on Inorganic Chemistry
X Brazilian Meeting on Rare Earths
III Workshop on Theoretical Bioinorganic Chemistry
Belo Horizonte, September 12 - 15th 2024

Color-changing or Glow? Eco-Multifunctional Hackmanites - Have It All!

Leonnam G. Merízio[1,2], Ian P. Machado[2,3], Roosa Vastamäki[2], Andréa S. S. de Camargo[4,5] and Mika Lastusaari[2]

[1] *São Carlos Institute of Physics, University of São Paulo (IFSC/USP), São Carlos-SP, Brazil*
[2] *Department of Chemistry, University of Turku, Turku, Finland*
[3] *NanoSensing Group, Department of Chemistry, Ghent University, Ghent, Belgium*
[4] *Federal Institute for Materials Research and Testing (BAM), Berlin, Germany*
[5] *Friedrich-Schiller University Jena (FSU), Jena, Germany*

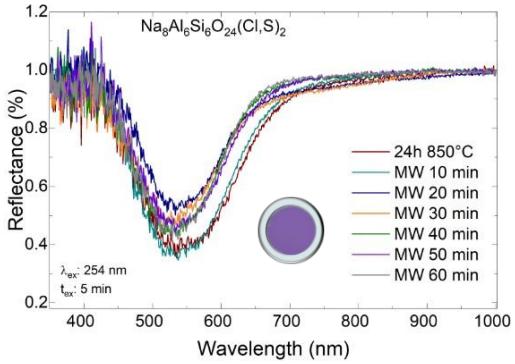
E-mail: lmerizio@ifsc.usp.br

Thematic Area: Materials Chemistry

Keywords: Hackmanite, Persistent Luminescence, Photochromism

Advanced photonic and luminescent materials have a wide range of applications in modern society, including solid-state lighting and high-energy radiation detectors. However, the majority of commercially available materials for these purposes contain heavy metals, which have a negative impact on the environment. On the other hand, naturally occurring optical minerals, such as hackmanites, have inspired the development of new environmentally friendly alternatives. Natural or synthetic hackmanites with the composition $M_8Al_6Si_6O_{24}(X,S)_2$ (M: Li^+, Na^+; X: Cl^-, Br^-), which contain only light elements, can exhibit photochromism or persistent luminescence (PersL) phenomena, expanding their application potential.[1–3] In this work, we have demonstrated the versatility of Hackmanite-based compounds prepared by conventional Solid-state and the rapid and energy-saving Microwave-Assisted Solid-State (MASS) methods. The materials were prepared by varying the composition in order to obtain Photochromic or Persistent Luminescent properties. The using of Li^+ and doping with a small amount of Ti^{3+} favors the PersL phenomenon. On the other hand, the no-doped materials presented photochromic properties. Overall, the MASS method allowed the obtention of the material in less than 60 min of synthesis. This is a great advantage when compared with the 24 h of conventional solid-state synthesis.

a) Photochromic



b) Persistent Luminescent

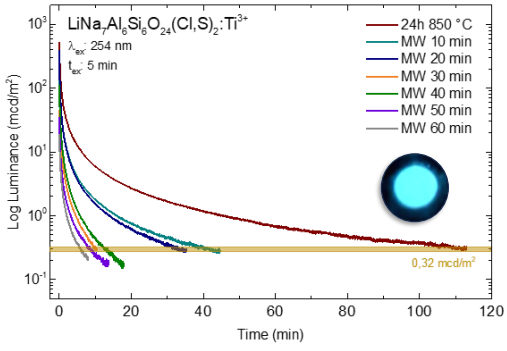


Figure 1. a) UV-Vis absorption spectra of the photochromic $Na_8Al_6Si_6O_{24}(Cl,S)_2$ materials, and b) absolute luminance decay of PersL $LiNa_7Al_6Si_6O_{24}(Cl,S)_2:Ti^{3+}$ materials.

Acknowledgments: FAPESP (Grants 2013/07793-6, 2021/08111-2, 2019/21770-5 and 2022/07667-0).

References

[1] Byron H.C. et al., Adv Funct Mater. **33**, 2303398, (2023).
[2] Norrbo I., et al. ACS Appl Mater Interfaces. **8**, 11592-11602, (2016).
[3] Vuori S., et al. Adv Opt Mater. **9**, 2100762, (2021).