VIDEO ARTICLE

Vid. Proc. Adv. Mater., Volume 2, Article ID 2102107 **(2021)**

Optical Glasses for Smart White Lighting and Solar Cells Applications: Where Do We Stand?

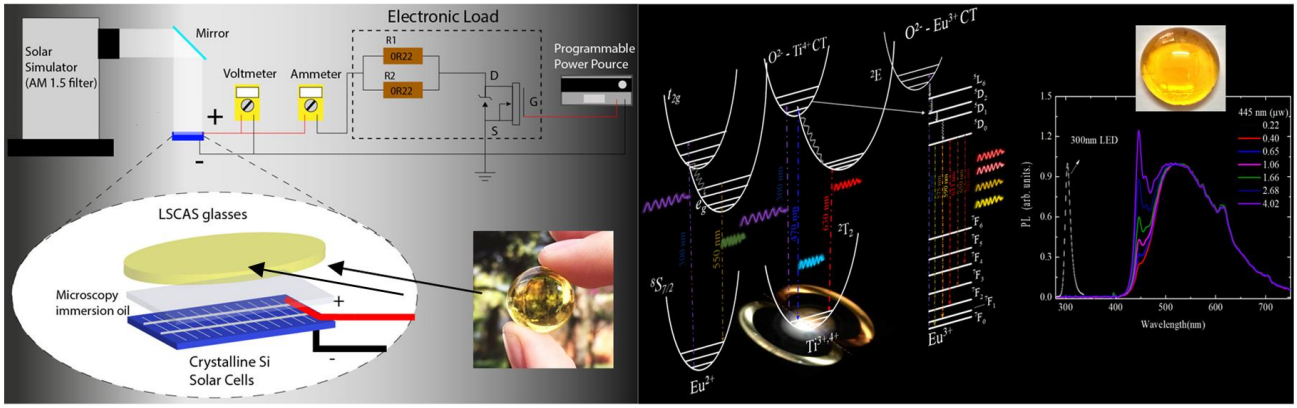
M.L. Baesso[1,*], A.C. Bento[1], A. Novatski[2], L.H.C. Andrade[3], S.M. Lima[3], L.A.O. Nunes[4]

[1]Physics Department, State University of Maringá, Maringá, 87020-900, Brazil
[2]Physics Department, State University of Ponta Grossa, Ponta Grossa, 84030-900, Brazil
[3]Centro de Estudos em Recursos Naturais- CERNA, Universidade Estadual de Mato Grosso do Sul, Dourados, 79804-970, Brazil
[4]Institute of Physics, University of São Paulo, São Carlos, 13566-590, Brazil

*Corresponding and Presenting Author. E-mail: mlbaesso@uem.br

DOI: 10.5185/vpoam.2021.02107

Graphical Abstract



Abstract

In the last decades many efforts have been done in order to obtain new materials for the development of more efficient solar cells and tunable white lighting. OH- free low silica calcium aluminosilicate glasses (LSCAS) have been attracting attention towards these applications owing to their high resistance against chemical degradation, high transparency from the UV to the near infrared (~5 μm) spectral regions, excellent optical quality, superior thermomechanical properties and low phonon energies (~850 cm 1) compared to other oxide glasses [**1-5**]. When doped with Ce, Ce-Eu, Eu-Pr and Eu-Ti these glasses presented broad emission bands towards the visible range, suggesting this system as a promising candidate for tunable artificial lighting [**1-4**]. On the other hand, solar panels efficiency is known to be highly dependent on the spectral matching between the solar spectrum and the active material band-gap. Much effort has been done towards the development of new solar energy absorbers aiming efficient downconversion processes to convert high energy photons from the visible range into low-energy ones close to the silicon band gap in the near infrared, being therefore sensitizers to improve the performance of the silicon solar cells [**5**]. In this live, an up to date review on the luminescence properties of ion doped LSCAS glasses will be discussed.

Comparison between other family of optical glasses and crystalline phosphors will be made. The glasses were melted under vacuum atmosphere to minimize OH^- molecules absorption in the near infrared region, improving therefore their luminescence quantum yield. In addition, this melting procedure has been shown to facilitate the tailoring of different oxidation states of the doping ions in the glass structure, allowing to play with the energy transfer process to enhance specific emissions. The focus will be on possible applications as spectral converters for efficient emission at the silicon band gap for solar cells, with special attention to the glasses co-doped with Eu, Nd and Yb ions, and also as glasses for tunable white lighting when doped with Ce, Eu, Pr and Ti ions, emphasizing possible advantages in eventual future applications as noncrystalline WLEDs devices.

Keywords: Glass phosphors; spectral converters; aluminosilicate glasses; luminescence.

Acknowledgements

We are thankful to Companhia Paranaense de Energia Elétrica (Copel), CAPES, FINEP, Fundação Araucária and CNPq for the financial support of this work.

References

1. C.Y. Morassuti, S. Finoto, J.R. Silva, L.A.O. Nunes, Y. Guyot, G. Boulon, M.L. Baesso, A.C. Bento, J.H. Rohling, S.M. Lima, L.H.C. Andrade. *J. Alloys and Comp.* In Press **2020**.
2. L.H.C. Andrade, S.M. Lima, A. Novatski, A. Steimacher, J.H. Rohling, A.N. Medina, A.C. Bento, M.L. Baesso, Y. Guyot, G. Boulon. A step forward toward smart white lighting: Combination of glass phosphor and light emitting diodes. *Appl. Phys. Lett.*, **2009**, *95*, 2007.
3. L.H. Andrade, S.M. Lima, A. Novatski, P.T. Udo, N.G.C. Astrath, A.N. Medina, A.C. Bento, M.L. Baesso, Y. Guyot, G. Boulon. Long fluorescence lifetime of Ti3+-doped low silica calcium aluminosilicate glass. *Phys. Rev. Lett.*, **2008**, *100*, 2.
4. A.C.P. Rocha, L.H.C. Andrade, S.M. Lima, A.M. Farias, A.C. Bento, M.L. Baesso, Y. Guyot, G. Boulon. Tunable color temperature of Ce3+/Eu2+,3+ co-doped low silica aluminosilicate glasses for white lighting. *Opt. Express.*, **2012**, *20*, 10034.
5. L.J. Borrero-Gonzalez, L.A.O. Nunes, G. S. Bianchi, F.B.G. Astrath, M.L. Baesso. Near-infrared quantum cutting in OH− free Nd3+-Yb3+ co-doped low-silica calcium aluminosilicate glasses. *J. Appl. Phys.*, **2013**, *114*, 013103.

Biography of Presenting Author

Mauro Baesso, Natural of Adamantina, SP, Brazil, 11-23-1959. Graduated in Physics at Universidade Estadual de Maringá (1990), obtained PhD in physics at IFGW-UNICAMP (1990). In 1990 obtained a permanent position at Universidade Estadual de Maringá, where in 2010 became full professor. Has been developing research and innovation on optical glasses and Photohermal methods for translational studies on material science and biological/biomedical systems. The studies involved experimental/ theoretical works related to ions doped low silica aluminate glasses for solid state lasers, smart white lighting and spectral converters for solar cells and on Photohermal methods like Thermal lens/mirror, Photomechanical mirror and Photoacoustics. Has been involved on interdisciplinary work focusing synthesis and characterization of OH- free low silica calcium aluminosilicate glasses for

development of solid-state lasers, tunable white lighting and spectral converters for solar cells. Has also worked on the development of photothermal methods for innovative applications in optical materials, biological and biomedical systems. Under his guidance several students developed experimental and theoretical works focusing new optical glasses and better description and experimental arrangements of photothermal methods for quantitative studies of the material thermophysical properties. Nowadays these studies have been applied in material science, physics, chemical physics, biophysics, biomedical, pharmaceutical and biochemistry areas. Other contributions have been done as pioneering works, contributing to the carriers. The actions accounted for more than seventy supervisions concluded worldwide. Published over 330 papers in high standard journals, 5 patents, H index = 47, over 7,500 citations and several project grants. Was also the Rector of the Unversidade Estadual de Maringá, from 2014 to 2018.

Citation of Video Article

Vid. Proc. Adv. Mater., Volume 2, Article ID 2102107 **(2021)**

Full Video Article www.proceedings.iaamonline.org/article/vpoam-2021-02107