Designing All-Photonic Molecular Analogs for Electrical Components: A Reprogrammable Luminescent Filter Based on Ln^{3+} Ions

Miguel A. Hernández Rodríguez[1,*], Sofia Zanella[1], Lianshe Fu[1], Albano N. Carneiro Neto[1], Luís D. Carlos[1], Carlos D.S. Brites[1,*]

[1]Phantom-g, CICECO-Aveiro Institute of Materials, Physics Department, University of Aveiro, 3810-193 Aveiro, Portugal

e-mail: miguelandreshr@ua.pt; carlos.brites@ua.pt

The increasing demand for computing power and downscaling is reaching the limits of incompatibility with the lithographic methods limitations, precluding further the shrinkage of the electronic components using state-of-the-art top-down approaches.[1,2] In addition, the current chip shortage exposes the excessive world dependence on silicon, stressing the need for silicon-free active and passive components. Among the diverse strategies followed so far, molecules that can replace the active electronic components is emerging as a promising alternative, combining the reduced dimensions with a new paradigm of interaction using photons instead of electrons.[3,4] Here, a Eu^{3+}/Tb^{3+} co-doped organic-inorganic di-ureasil hybrid is used to demonstrate an illustrative example of an all-photonic device based on the emission temporal dynamics of the Eu^{3+} and Tb^{3+} ions. An all-photonic approach for temperature-reprogrammable change from a low-pass filter to a high-pass filter is reported, showing a firm step toward the design and development of molecular analogs of conventional circuit electrical passive components.

Acknowledgement: *This work was developed within the scope of the projects CICECO-Aveiro Institute of Materials (UIDB/50011/2020 & UIDP/50011/2020) and LogicALL (PTDC/CTM-CTM/0298/2020) financed by national funds through the FCT/MCTES (PIDDAC). S.Z. and M.A.H.R. acknowledge, respectively, FCT for the Ph.D. grant (SFRH/BD/144239/2019) and the support of LogicALL.*

References

[1] A. P. de Silva, S. Uchiyama, *Nat. Nanotechnol.* **2007**, *2*, 399. DOI:10.1038/nnano.2007.188

[2] P. Gould, *Mater. Today* **2005**, *8*, 56. DOI: 10.1016/S1369-7021(05)70987-1

[3] M. A. Hernández-Rodríguez, C. D. S. Brites, G. Antorrena, R. Piñol, R. Cases, L. Pérez-García, M. Rodrigues, J. A. Plaza, N. Torras, I. Díez, A. Millán, L. D. Carlos, *Adv. Opt. Mater.* **2020**, *8*, 2000312. DOI: 10.1002/adom.202000312

[4] S. Zanella, M. A. Hernández-Rodríguez, L. Fu, L. D. Carlos, R. A. S. Ferreira, C. D. S. Brites, *Adv. Opt. Mater.* **2022**, *10*, 2200138. DOI: 10.1002/adom.202200138