Curcuminoids: Molecular Platforms for Electronic and Sensor Purposes

Núria Aliaga-Alcalde[1,2]
Raquel Gimeno-Muñoz,[1] Raúl Díaz-Torres,[1] Laura Rodríguez-Cid,[1] Daniel Riba-López,[1] Teresa Cardona-Lamarca,[1] Daniel Herrera-Miranda,[1] Concepción Domingo,[1] Diana Dulic,[3] Herre J. S. van der Zant,[4] Mònica Soler,[5] Eliseo Ruiz,[6] Arántzazu González-Campo[1]

[1]ICREA (Institució Catalana de Recerca i Estudis Avançats), Passeig Lluís Companys, 23 08018 Barcelona, Spain
[2]ICMAB-CSIC (Institut de Ciència dels Materials de Barcelona), Campus de la Universitat Autònoma de Barcelona, 08193 Bellaterra, Spain
[3]Departamento de Física, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago de Chile, Chile
[4]Kavli Institute of Nanoscience, Delft University of Technology, Lorentzweg 1, 2628 CJ Delft, The Netherlands
[5]Departamento de Ciencia de los Materiales, Facultad de Ciencias Físicas y Matemáticas, Universidad de Chile, Santiago, Chile
[6]Universitat de Barcelona, Facultat de Química, Diagonal 645, 08028 Barcelona, Spain
nuria.aliaga@icrea.cat / naliaga@icmab.es

Nowadays, curcuminoids (CCMoids)[1-9] and related coordination compounds are progressively explored besides biomedicine (e.g.: photovoltaics[2] and MOFs[3]) in additional contributing areas of Nanoscience and Nanotechnology due to their structural nature and versatile chemistry.
During the last years, my group has designed a number of these molecules as metal-anticancer agents,[4] single-molecule magnets[5-6] and coordination polymers.[7] Moreover, their conjugated skeleton and adaptable endings have triggered their study in Molecular Electronics as molecular wires between Au[8] and graphene[9] electrodes. The use of extra functional groups allows their attachment to different surfaces, exploring this way their luminescent properties.
Here, I would like to emphasize our work in the last two topics: (i) single-molecule transport studies of CCMoids using mechanically-controllable break junction technique (MCBJ)[8] and (ii) surface engineering, with the creation of patterns on substrates using micro-contact printing technique (μ-CP). In the former, the combination of a CCMoid, containing methylthio units as anchoring groups and boron coordination promotes electric-field induced bistability in conductance measurements at the single molecule level.[8] The second shows that CCMoids, with fluorophore groups, are capable of functioning as sensors of boron materials acting, in some cases, as NIR fluorescent probes.
Our work emphasizes the potential of CCMoids as molecular key components in electronic devices and sensors owing to their thorough design.

REFERENCES

[1] Sanz-Mendiguchia, B.; Aiello I.; Crispini, A. Dalton Trans., 2015, 44, 9321.
[2] Castro, E.; Ceron, M. R.; Garcia-Hernandez, A.; Kim, Q.; Etcheverry-Berrios, A.; Morel, M. J.; DiazTorres, R.; Qian, W.; Martinez, Z.; Mendez, L.; Perez, F.; Santoyo, C. A.; Gimeno-Muñoz, R.; Esper, R.; Gutierrez, D. A.; Varela-Ramirez, A.; Aguilera, R. J.; Llano, M.; Soler, M.; Aliaga-Alcalde, N.; Echegoyen, L. RSC Adv., 2018, 8, 73, 41692.
[3] Su, H.; Sun, F.; Jia, J.; He, H.; Wang, A.; Zhu, G. Chem. Commun. 2015, 51, 5774.
[4] Aliaga-Alcalde, N.; Marqués-Gallego, P.; Kraaijkamp, M.; Herranz-Lancho, C.; den Dulk, H.; Görner, H.; Roubeau, O.; Teat, S. J.; Weyhermüller, T.; Reedijk ,J. Inorganic Chemistry, 2010, 49, 9655.
[5] Menelaou, M.; Ouharrou, F.; Rodríguez, L.; Roubeau, O.; Teat, S. J.; Aliaga-Alcalde, N. Chem. – Eur. J. 2012, 18, 11545.
[6] Díaz-Torres, R.; Menelaou, M.; Roubeau, O.; Sorrenti, A.; Brandariz-de Pedro, G.; Sañudo, E. C.; Teat, S. J.; Fraxedas, J.; Ruiz, E.; Aliaga-Alcalde, N. Chem. Sci., 2016, 7, 2793.
[7] L. Rodríguez-Cid, E. C. Sañudo, A. M. López-Periago, A. González-Campo, N. Aliaga-Alcalde, C. Domingo, Crystal Growth and Design, 2020, 20, 6555.
[8] Olavarria-Contreras, I. J.; Etcheverry-Berrios, A.; Qian, W.; Gutierrez-Ceron, C.; Campos-Olguin, A.; Sanudo, E. C.; Dulić, D.; Ruiz, E.; Aliaga-Alcalde, N.; Soler, M.; van der Zant, H. S. J. Chem. Sci., 2018, 9, 34, 6988.
[9] E. Burzurí, J. Island, R. Díaz-Torres, A. Fursina, A. González-Campo, O. Roubeau, S. J. Teat, N. Aliaga-Alcalde, E. Ruiz, H. S. J. van der Zant, ACS Nano, 2016, 10 (2), 2521.