From luminescent imidazolium salts to tools for biology

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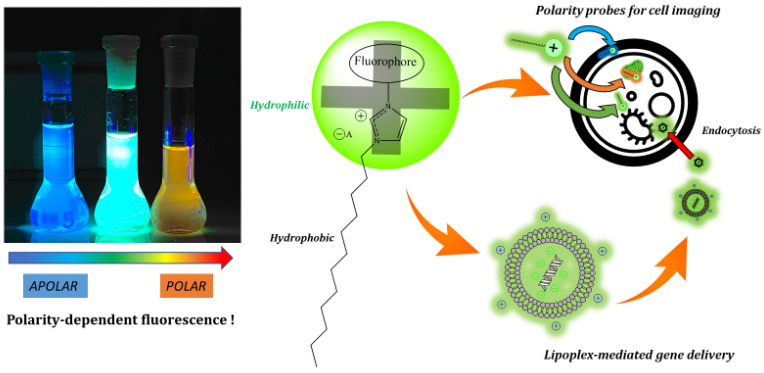
Over the last two decades, ionic liquid crystals have experienced a real boom, and research in this field has led to the synthesis of numerous molecular structures with mesomorphic properties. This craze is due to the high stability (extremely low volatility, high thermal stability, non-flammability, high chemical and radiochemical stability, high ionic conductivity and wide electrochemical window) of these salts, but also to the weak interactions and bonds that allow the emergence of self-organised mesomorphic systems reinforced by ionic interactions. The physical properties of these salts, such as viscosity, melting point, polarity and hydrophilicity/hydrophobicity, can be finely tuned by varying the anion. The cation in the organic backbone affects the amphipathic character (balance between two antagonistic parts: rigid aromatic part/flexible alkyl chains) that controls the self-organising architectures in the liquid crystal state. These unique properties have led to applications ranging from display technology to biological activity (targeting and transport of drugs and genetic material), or even templating media for synthesis.[1] Light and associated phenomena, such as luminescence, have proved to be powerful tools with great sensitivity for exploring the infinitely small. Molecular salts, particularly those based on imidazolium units, have attracted the attention of the scientific community because of their original properties and structural versatility. When functionalized with fluorophores[2,3], they constitute efficient and highly bioavailable platforms, for example for ion detection and cell imaging, opening the way to theranostics (therapy and diagnosis). The interactions they can establish with negatively charged species and biological membranes, as well as their controllable cytotoxicity, have given them applications as anion receptors, but also promising potential as antibacterial and anticancer agents whose mechanism of action can be observed using luminescence. The PhD will consist of multi-step syntheses to prepare ionic molecules and characterise their mesomorphic characteristics and luminescence properties. The study of their transfection and bio-imaging properties will be carried out in collaboration with biologists (A. Kichler and A. Klymchenko, Illkrich Faculty of Pharmacy).



[1] **Mesomorphic Imidazolium Salts: New Vectors for Efficient siRNA Transfection**. Dobbs, W.; Heinrich, B.; Bourgogne, C.; Donnio, B.; Terazzi, E.; Bonnet, M.-E.; Stock, F.; Erbacher, P.; Bolcato-Bellemin, A.-L.; Douce, L. *Journal of the American Chemical Society* **2009**, *131*, 13338-13346.2)**.**
[2] **Luminescent Imidazolium Salts as Bright Multi-Faceted Tools for Biology.** R. Berthiot, N. del Giudice and L. Douce, *European Journal of Organic Chemistry* **2021**, 29,4099-4106. (DOI:10.1002/ejoc.202100459).
[3] Cover Page: **Luminescent Ionic Liquid Crystals Based on Naphthalene-Imidazolium Unit.** (*DOI: 10.1002/ejoc.202100374*) del Giudice, N., M. L'Her, E. Scrafton, Y. Atoini, G. Gentile, B. Heinrich, R. Berthiot, A. Aliprandi and L. Douce, European Journal of Organic Chemistry **2021**, (DOI:10.1002/ejoc.20210004).