Oral presentation

Emergence of liquid-crystalline properties in perovskite-like materials based on polyfluorinated imidazolium cations

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Hybrid Organic-Inorganic Halide Perovskites (HOIHP) have emerged as promising materials in semiconductor technology. Their easy and low-cost production together with their unique optoelectronic properties make them promising materials, for a multitude of applications including light-emitting diodes, lasers, photodetectors, scintillators, field-effect transistors and photovoltaics (PVs) [1,2]. Despite their meteoric growth, many challenges related to their stability in prolonged environmental exposure (moisture, oxygen, irradiation) need to be addressed for their implementation in the real world. Addressing these minus requires a deep understanding and control of structure-properties relationships, which at the moment are still missing.
In this communication, unprecedented quasi-zero dimensional perovskites based on polyfluorinated imidazolium cations will be described [3]. These new fluorinated materials show intrinsic liquid-crystalline behaviour over a wide range of temperatures, with enantiotropic smectic A phase, which is reminiscent of the lamellar phase observed in the crystal state. The lamellar order, both in the solid- and liquid-crystalline states, is directed by segregation and promoted by manifold intermolecular F···F interactions between the polyfluorinated chains of the imidazolium cations. Moreover, the structure of the incorporated imidazolium cation was found to tune the properties of the liquid crystalline phase. Collectively, these results may pave the way for the design of a new class of halide perovskite-based soft materials.

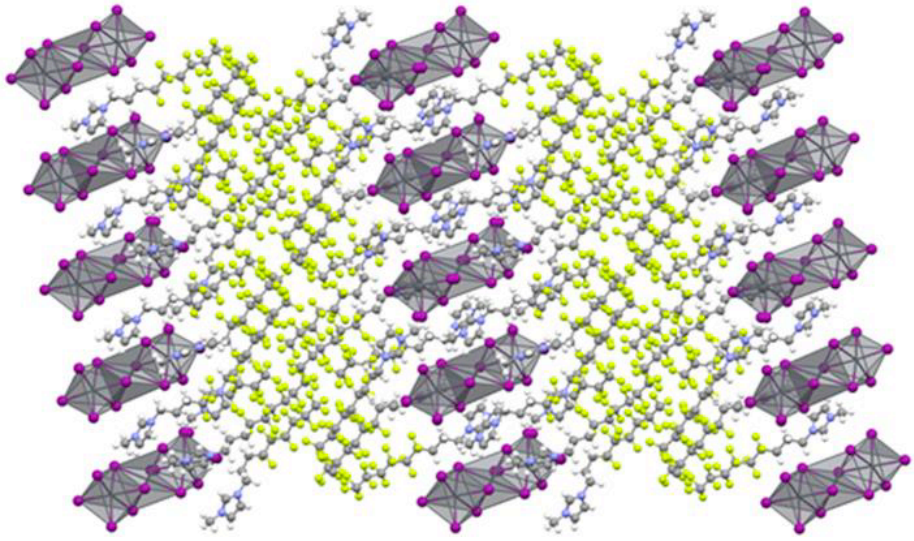

Figure 1. Representation of the crystal packing of a quasi-zero dimensional lead-halide perovskite based on polyfluorinated imidazolium cations. Colour and style code: $Pb_3I_{12}^{6-}$, polyhedral representation; Pb, dark grey; I, purple; $MeImC_9H_6F_{13}^{+}$, ball and stick representation; C, grey; N, light blue; F, yellow; H, white.

[1] Li, X., Hoffman, J. M. & Kanatzidis, M. G. (2021). Chem. Rev. ***121****, 2230.*

[2] Metrangolo, P., Canil, L., Abate, A., Terraneo, G. & Cavallo G.(2022). Angew. Chem. Int. Ed. ***61****, e202114793.*

[3] Stergiou, A., Leccioli, L., Ricci, D., Zaffalon, M. L., Brovelli, S., Baldelli Bombelli, F., Terraneo, G., Metrangolo, P. & Cavallo, G. (2024). Angew. Chem. Int. Ed. under revision.