Development of nonvolatile liquid anthracenes for facile full-colour luminescence tuning

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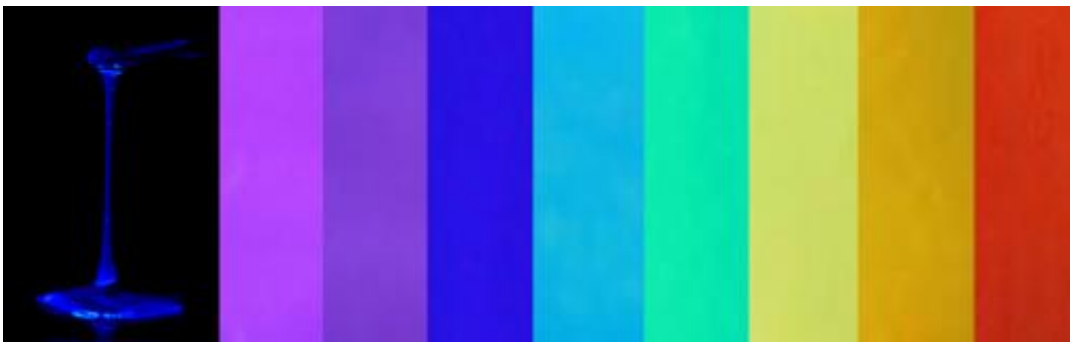

Full-colour luminescence panels under ultraviolet (365nm) irradiation by adjustment of the nonvolatile blue-emitting anthracene liquid (left: photo) in the material.

A research team from the National Institute for Materials Science has developed a full-colour tunable luminescent liquid material with excellent photostability based on anthracene, which is a general organic fluorescent dye.

In the development of full-colour display monitors, mobile devices, and other electronic devices, organic molecular and polymer materials are essentially important, as they offer advantages such as light weight, flexibility, and printability. However, in virtually all cases, the light-emitting organic molecular materials developed until now have had

difficulties to demonstrate their inherent luminescent performance due to various problems, which include low photostability (durability to prevent discoloration or decolorization under photoirradiation) and aggregation of molecules in the coating process. Moreover, from the viewpoint of production of flexible devices, materials should be free of deterioration of the continuous emissive layer, even when subjected to excessive bending and folding. On the other hand, development of organic molecular materials which enable simple, low-cost manufacture of full-colour luminescence devices, in comparison with individual synthesis of organic molecular materials that display various luminescent colours, is also desired.

The team led by Dr. Nakanishi developed a blue-emitting liquid material which is free of aggregation among adjacent anthracene parts, has a melting point of approximately -60 °C, and is thermally stable up to about 300 °C, by attaching highly flexible branched alkyl chains around an anthracene core moiety, which is a fluorescent general dye molecule. This material is a low-viscosity liquid with viscosity of approximately 0.3 Pa-s at room temperature and is a blue-emitting with an absolute fluorescence quantum yield of ca. 55% and photostable more than 5~10 times longer lifetime than that of commercially-available anthracene dyes. Furthermore, because other luminescent dye molecules can be doped homogeneously in this liquid, it was found that full-colour luminescence tuning is available assisted by up to 96% fluorescence resonance energy transfer (FRET) of dyes by single blue-light (365nm) excitation.

In this research, a blue-emitting anthracene liquid with excellent photostability was synthesized, and a liquid material which displays high quality full-colour luminescence and precise luminescence tuning by the facile operation of doping the liquid with other dyes was developed. Since the nonvolatile liquid material developed in this work can be coated on the surface of various substrates, production of organic

multicolour devices with stable single color excitation can be expected. A continuous active emitting layer can be maintained, without breaking or interruption even when bent and folded, which is a favorable property for the development of foldable flexible devices.

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