New liquid crystals prevent automobile touch screens from freezing

February 9 2016

In addition to appearing in nearly every consumer electronic device, liquid crystal displays have recently proliferated in automobiles too, in heads-up displays, instrument cluster displays, navigation systems and entertainment displays. Due to limitations in current display technology, the images blur and the displays are slow to respond in extreme temperatures.

"When we turn on the car, we want to be certain our GPS is functioning properly and not affected by extreme winter or summer temperatures," said Shin-Tson Wu, Pegasus Professor of Optics and Photonics, University of Central Florida - College of Optics and Photonics, USA.

Wu and his colleagues from the University of Central Florida, Xi'an Modern Chemistry Research Institute in Xi'an, China, and DIC Corporation, Japan, have recently developed three new liquid crystal mixtures that overcome previous physical limitations on upper and lower operation temperatures. They report their results this week in *Optical Materials Express*, a journal published by The Optical Society (OSA).

According to Wu, the liquid crystals should have a clearing point higher than 100° C (or 212° F), and a melting point below -40° C (or -40° F). Beyond this range, the liquid crystal would be non-functional because it will be either frozen or isotropic.

To keep their liquid crystals operating at such a wide temperature range, the researchers mixed a dozen three-ring and four-ring compounds together with low molecular weight compounds. This type of mixture is considered a eutectic system. In addition to boosting the clearing point, the mixtures exhibit low viscoelastic coefficients and activation energies. These properties play a key role in maintaining low viscosity of the liquid crystals at low temperatures, as the response time of a liquid crystal display device is mainly governed by the viscoelastic coefficient and the liquid crystal layer thickness.

As noted in the paper, current European automotive standards require a response time for pixels to change from one brightness to another of 200 milliseconds at -20° C (or -4° F) and 300 milliseconds at -30° C (or -22° F), which are insufficiently rapid to avoid an image blur. The response time reported by Wu and his colleagues is about 10 milliseconds – roughly 20 times faster than the European requirements. Additionally, these mixtures enable field-sequential color display at an elevated temperature, which results in a tripling in resolution density and display brightness. This approach improves the ambient contrast ratio of heads-up displays in the daytime.

Future work for Wu and his colleagues includes developing extremely thin liquid crystal displays for integration with rearview mirrors to eliminate blind spots for drivers, as well as improving the readability of all types of automotive displays in harsh sunlight.

More information: Fenglin Peng et al. High performance liquid crystals for vehicle displays, *Optical Materials Express* (2016). DOI: 10.1364/OME.6.000717

Provided by Optical Society of America