

New ionic liquid in thermometers beats mercury on range, performance and safety

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Poisonous mercury in thermometers has been replaced by harmless and better performing ionic liquids in research by scientists from Europe and the US, published in the Royal Society of Chemistry journal *Green Chemistry*.

Ionic liquids (ILs) are salts in liquid form and already have a wide range of applications, from use in drug delivery to fuel cells and batteries. Robin Rogers of Queen's University of Belfast, UK, and his colleagues have now found another role for them. "We have known the basic properties of ILs and have thought for some time that they should make a great thermometer fluid," says Rogers. "We simply had to prove it!"

ILs offer several advantages for thermometers: they have a faster temperature response time compared with mercury and operate over a wider range of temperatures compared with many molecular liquids, including ethanol.

Non-toxic ILs can be used and their low volatility reduces their ability to escape into the environment, giving an additional environmental advantage over mercury, which needs to be carefully disposed of if a thermometer is broken.

To make its thermometers the US team used normally colourless ionic liquids coloured red with an IL-dye. This made the liquid level easily visible without affecting the linear relationship between liquid volume and temperature. The thermometers could be adapted for a particular

temperature range by changing the make-up of the liquid.

Rogers and colleagues chose an ammonium-based liquid for general applications, as it is economical and non-toxic. They also used an alkylphosphonium-based liquid for a more specialised thermometer with a wider temperature range.

Rogers suggests that the thermometers could have uses both in industry and research and development. “Specialty thermometers with a suitable liquid range could be interesting for operation under extreme environment conditions,” he says, “for example, Antarctica and deep sea vents.”

Gary Baker, who also works with ILs, at Oak Ridge National Laboratory, US, says that “using an IL as a filling fluid toward a new class of liquid-in-glass thermometer nicely illustrates the broad potential of ILs as potentially green replacements for conventional solvents.” He adds that “the work opens up yet another avenue in engineering science, as ILs continue to find relevance in increasingly diverse areas.”

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