Piezoelectric effect in liquids observed for the first time

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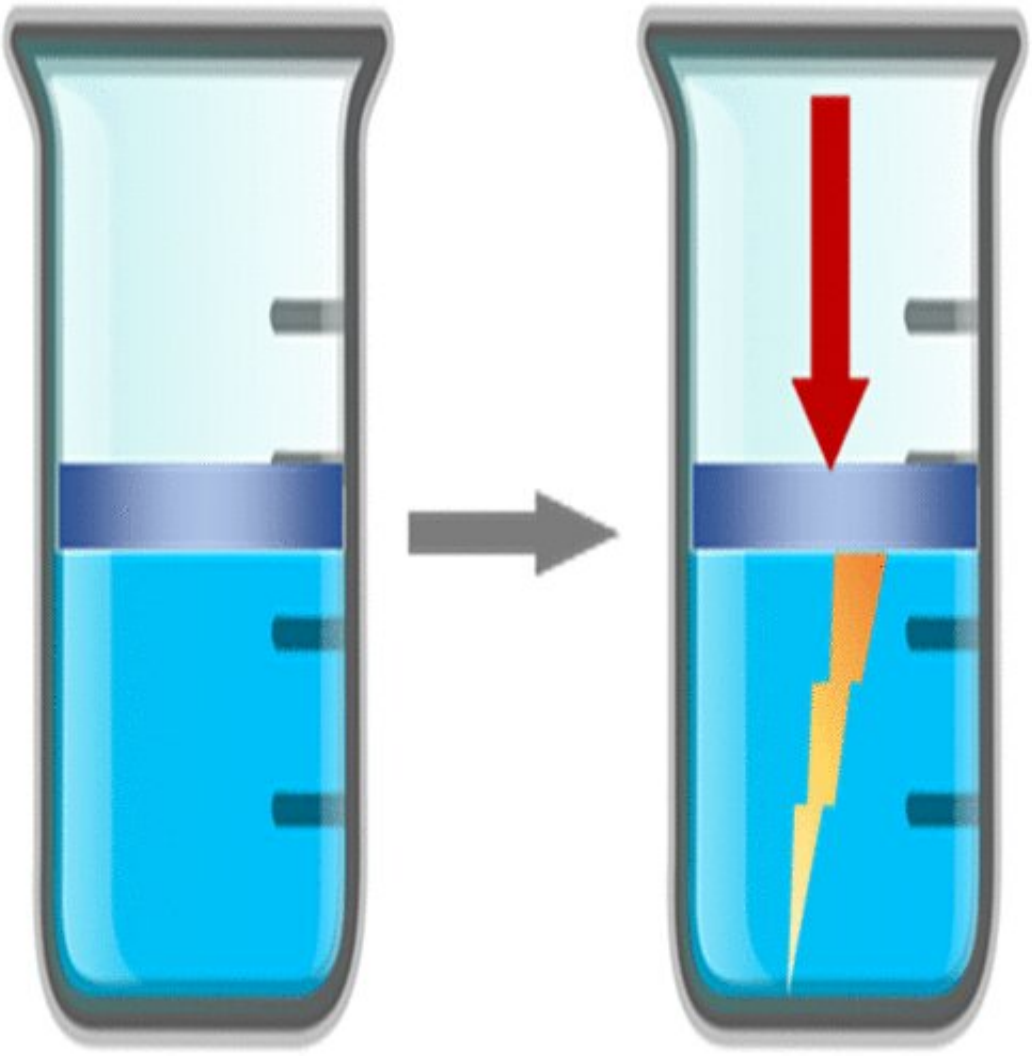

Graphical abstract. Credit: *The Journal of Physical Chemistry Letters* (2023). DOI: 10.1021/acs.jpclett.3c00329

A pair of chemists at Michigan State University has observed the piezoelectric effect in liquids for the first time. In their paper published in *The Journal of Physical Chemistry Letters*, Md. Iqbal Hossain and G. J. Blanchard, describe accidently observing the property while studying ionic liquids.

Up until now, all piezoelectric materials have been solid. Such materials get their name due to a property that allows them to hold an electric charge and then to release it when stress is applied. These materials are currently used in products such as sonar equipment, guitar pickups and cellphone speakers. In this new research, the pair in Michigan found the first known example of a piezoelectric material that exists in liquid form at room temperature.

The researchers were studying properties of ionic liquids, which are made from salts with unsymmetrical, flexible organic cations and symmetrical weakly coordinating anions. Electricity builds up within them and is released when they are pressed or squeezed. The liquid piezoelectric material was discovered as the researchers applied pressure with a piston to a sample of an ionic liquid in a cylinder. To their surprise, they found that this led to the release of electricity. They also found that the amount of electricity released was proportional to the amount of pressure applied. Further testing showed that the optical properties of the ionic liquids changed when they released electricity. In some instances, the researchers found changes in how the liquid bent light.

They were not able to explain why the ionic liquids they tested had piezoelectric properties but suggest that applying pressure likely serves to separate charge within the fluid, allowing some to be released. They plan to continue studying the material to better understand why it behaved in the ways they observed.

The researchers also suggest that liquid piezoelectric materials could prove to be useful, especially ones made using ionic liquids, because they would be more environmentally friendly than solid materials. They also note that liquid piezoelectric materials could allow more variety in device shape, opening up wider design opportunities.

More information: Md. Iqbal Hossain et al, Ionic Liquids Exhibit the Piezoelectric Effect, *The Journal of Physical Chemistry Letters* (2023). DOI: 10.1021/acs.jpclett.3c00329