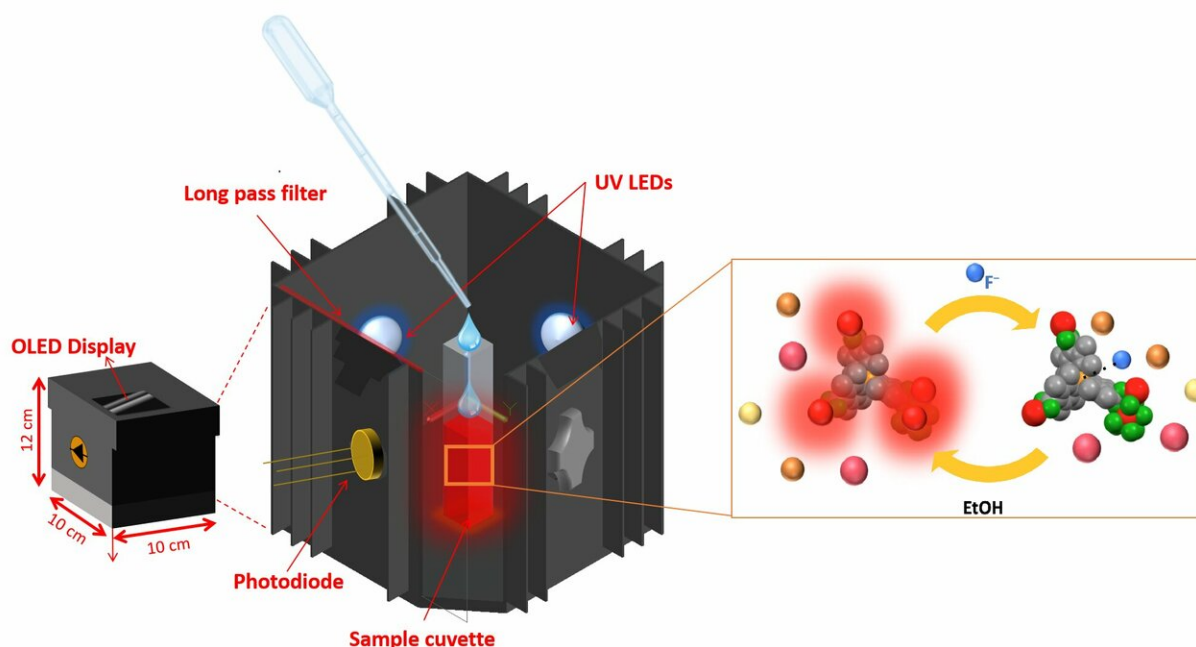


# New device simplifies measurement of fluoride contamination in water

February 18 2019



A diagram of the SION-105 prototype device: A vial containing a red luminescent suspension of SION-105 crystals is placed inside the device. When two drops of water sample are added to the vial, resulting changes in the brightness of SION-105 are measured by the photodiode, and instantly converted into an accurate quantitative reading of the fluoride concentration in the sample. The inset is a schematic of how the luminescence is quenched at the molecular level. Credit: Mish Ebrahim

Adding fluoride to water is common practice in a number of countries, including the U.S., Australia, Brazil, Malaysia, India and Vietnam. In low concentrations (below 1.5 mg/L), it can prevent tooth decay and even strengthen bones, but levels above that can have the opposite effect, causing serious dental and bone disease, especially in children and developing fetuses.

To keep things in check, the WHO has set 1.5 mg/L as the maximum limit for [fluoride](#) in drinking water. "To determine whether drinking water is safe, we need to detect fluoride in water at the level of parts-per-million (ppm)," says Kyriakos Stylianou at the Laboratory of molecular simulation at EPFL Valais Wallis. "Around one to 1.5 ppm is good for teeth, but in many countries, the [water sources](#) have concentrations above 2 ppm, which can cause serious health issues."

But measuring fluoride at such low concentrations with sufficient accuracy is expensive and requires a well-equipped chemical lab. Because of this, fluoride contamination in water affects a number of developing countries today, and even parts of developed countries.

Led by Stylianou, a team of scientists has now built a device that can accurately measure fluoride concentrations using only a few drops of water—even with low-level contamination—resulting in a simple change in color brightness. Published in the *Journal of the American Chemical Society (JACS)*, the device is named SION-105. It is portable, considerably cheaper than current methods, and can be used on-site by virtually anyone.



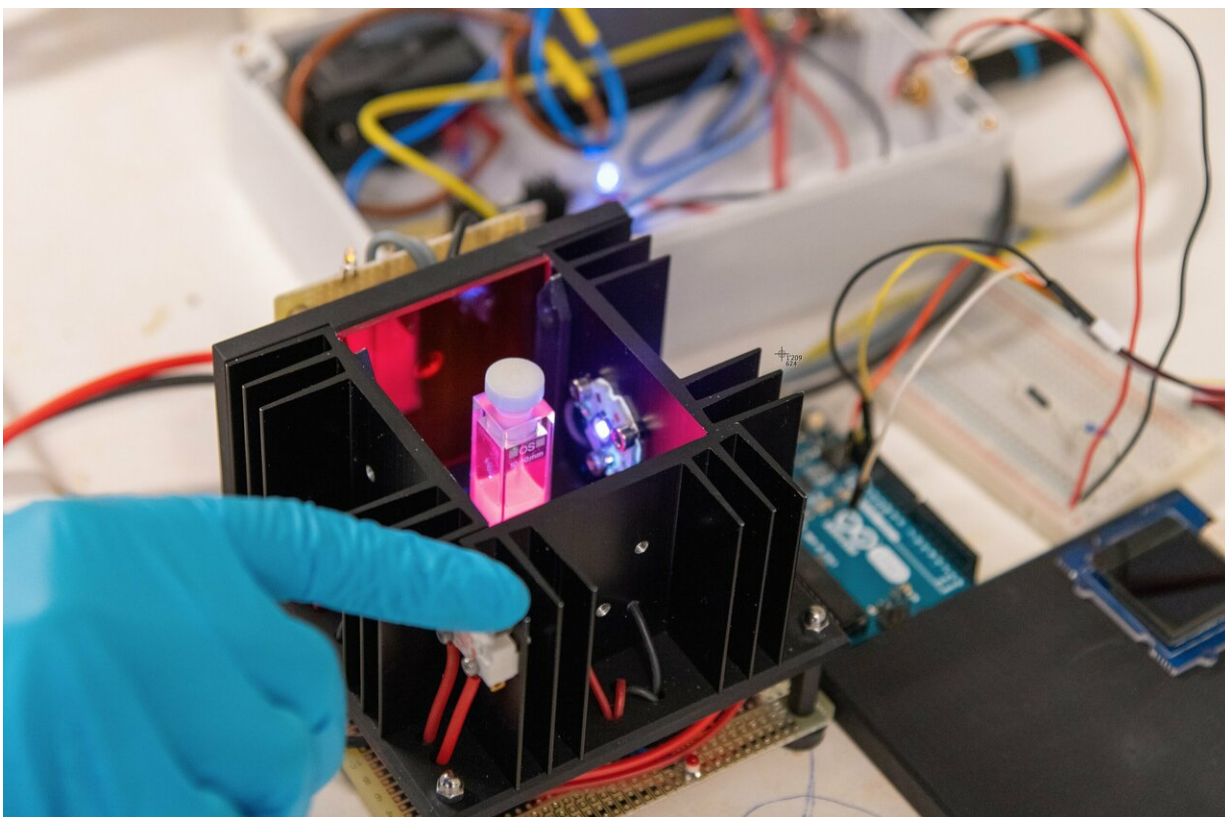
A photograph of SION-105 suspended in solvents with (L) and without (R) fluoride ion contamination. Credit: Mish Ebrahim (EPFL)

The key to the device is the design of a novel material that the scientists synthesized (and after which the device is named). The material belongs to the family of "metal-organic frameworks" (MOFs), compounds made up of a [metal ion](#) (or a cluster of metal ions) connected to organic ligands, thus forming one-, two-, or three-dimensional structures. Because of their structural versatility, MOFs can be used in an ever-growing list of applications, including separating petrochemicals, detoxing water, and getting hydrogen or even gold out of it.

SION-105 is luminescent by default, but darkens when it encounters

fluoride ions. "Add a few droplets of water and by monitoring the color change of the MOF, we can determine whether it is safe to drink the water or not," explains Mish Ebrahim, the paper's first author. "This can now be done on-site, without any chemical expertise."

The researchers used the device to determine the fluoride content in groundwater samples from Vietnam, the United Arab Emirates, and Saudi Arabia. The data corresponded very well when compared to measurements made using ion chromatography, a standard method for measuring fluoride concentration in water.



The prototype device used with SION-105 to detect fluoride anions in drinking water. Credit: Marie-Thé and Etienne Roux

"This comparison showcases the performance and reliability of SION-105, which, coupled with the portability and ease-of-use of the device, make it a very user-friendly solution for [water](#) sampling in [remote areas](#) where frequent fluoride [concentration](#) monitoring is paramount," says Stylianou.

**More information:** Fatmah Mish Ebrahim et al. A selective, fast-response and regenerable metal-organic frame-work for sampling excess fluoride levels in drinking water. *Journal of the American Chemical Society* 11 February 2019. [DOI: 10.1021/jacs.8b11907](https://doi.org/10.1021/jacs.8b11907)

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