



Industrial Consultancy & Sponsored Research (IC&SR)

A SMARTPHONE INTEGRATED FLUORIDE-SPECIFIC SENSOR FOR RAPID AND AFFORDABLE COLORIMETRIC DETECTION

IITM Technology Available for Licensing

PROBLEM STATEMENT

- Fluoride, a naturally occurring anion in groundwater, is crucial for tooth growth and bone maintenance but can cause dental and skeletal fluorosis.
- Exposure to F⁻ can lead to kidney and acute gastric problems.
- Techniques like ion-selective electrodes, F NMR analysis, mass spectrometry, and colorimetric sensing have been developed for real-time water quality data collection.
- Nanomaterials like gold and CeO₂ are used for aqueous F⁻ removal and nanosensors.
- Simple, stable, sensitive, and selective systems are preferred for environmental and health-related monitoring.

TECHNOLOGY CATEGORY MARKET

Technology: Smartphone type a real time fluoride detection.

Category: Environment Engineering

Industry: Water Quality Management.

Application: Aqueous samples and Dental care Products.

Market: The global market size of environmental technology was valued at **USD 575 billion in 2022** and it is expected to hit **USD 880 billion by 2032**, growing at a compound annual growth rate (CAGR) of **4.40% from 2023 to 2032**.

INTELLECTUAL PROPERTY

IITM IDF Ref. 2031

Patent No: IN 536268

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

Prof. Pradeep T,
Dept. of Chemistry, IIT Madras.

TECHNOLOGY

- ❑ The detection of fluoride at sub-ppm levels in field samples in real time by using the smartphone-integrated sensor device.
- ❑ smartphone-integrated sensor device comprises; -

Sensing material consisting of core shell near-cubic CeO₂-ZrO₂ nanocages of 50-60 nm edge length and a chemoresponsive dye

A housing for holding the sample

A LED (Light Emitting Diode) for illuminating the sample

A photodiode for collecting the signal

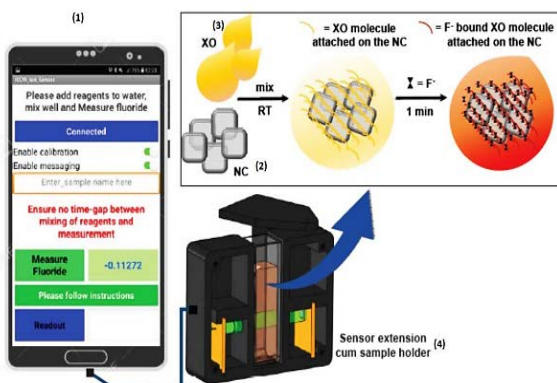


Figure 1 shows a Schematic representation of the smartphone based F-sensor and its sensing mechanism using near-cubic ceria@zirconia nanocages (NC) and xylenol orange (XO) dye.

CONTACT US

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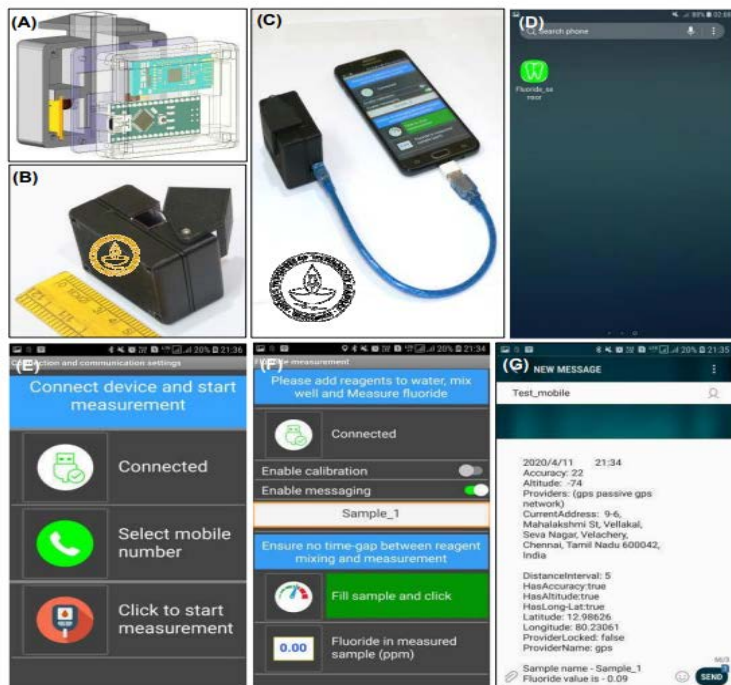


Figure 2 shows the following data

(A) Graphical representation of the extended sensor device cum sample holder.

(B) Photograph of the sensor extension cum sample holder.

(C) Photograph of the F-sensor integrated with a smartphone.

(D) Icon of the customized mobile application developed for the F-sensor.

(E) and (F) Screenshot images of the application of a pre-calibrated sensor for the detection process and for real-time data sharing and storage.

(G) Sample message.

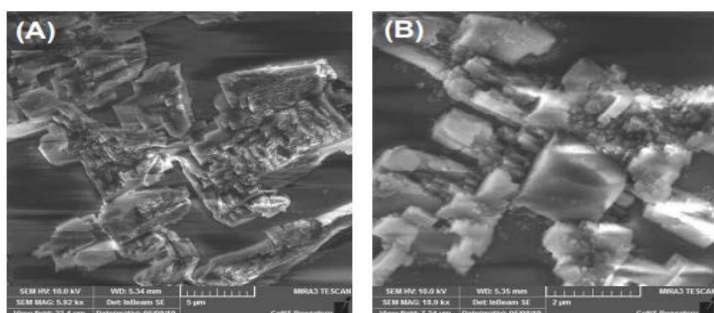


Figure 3 shows a Large area FESEM images for aggregation of ceria@zirconia nanocages after the interaction with F⁻ ions.

Key Features / Value Proposition

- ❑ A smartphone-based sensing platform has been developed for fluoride detection at sub-ppm levels in field samples in real time.
- ❑ Chemoresponsive organic dye is **Xylenol Orange**.
- ❑ The core is **ceria** and shell is **zirconia**.
- ❑ The study uses a collimated 565 nm LED for illuminating a sample and a photodiode for signal collection.
- ❑ The LED is a collimated 565 nm LED with luminous intensity of 700 mcd at 2.4 V.
- ❑ High performance in environmental water samples and dental care products.
- ❑ Do not uses any lens arrangement.
- ❑ High degree of sensitivity and specificity by using
 - ✓ A mixture of near-cubic ceria-zirconia nanocages and chemo-responsive dye (xylenol orange)
 - ✓ That one rapidly changes color from yellow to red upon interaction with fluoride down to sub-ppm levels.
- ❑ Spectral sensitivity in the region of 430-610 nm.
- ❑ **Sensitivity** range (0.1 to 5 ppm) of fluoride in field water samples.

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