

Executive Summary



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1. Title of the Project:

Design and Development of Low Power, Low Cost, High-Performance Gas Sensor Array for Exhale Breath analyser: A Point-of-Care based Non-Invasive Early Detection and Prognosis of Cardiovascular Diseases

2. Date of Start of the Project: 01.10.2022

3. Aims and Objectives:

A. Aim/Deliverables:

- a. A Sensor array Prototype must be developed to detect Cardiovascular Disease Biomarkers such as FENO, CO, Isoprene, Pentane and Trimethylamine (TMA) at ppm/ppb/ppt levels with reduced cross-reference between other biomarkers such as CO₂, Hydrocarbons, Moisture, O₂ etc.
- b. The signal conditioning circuit, which interfaces the data to the Mobile app assuring a point of care prognosis of CVD (Cardio Vascular Diseases) , has to be appended to the Sensor array prototype.
- c. Three prototypes shall be developed during the activity. Validation of the prototype in patient-derived breath samples (100 patients per year) from KIMS hospital (Kerala Institute of Medical Science), Trivandrum, will be performed.
- d. Licensing the technology and initiating the incubation activity.

B. Objectives:

- a. Biomarker Identification and Detection for CVD
- b. Synthesis and Characterization of Nanomaterials for Gas Sensing:
- c. Design and Development of Miniature Gas Sensor Array:
- d. Calibration of the Gas sensor with Dual Excitation (Opto-Thermo):

- e. Selective Detection of Biomarker (Gases) by Optimized Nanomaterials: Incorporation of suitable catalysts in the sensing materials.
- f. Evaluation of Exhale Breath prototype and validation
- 4. Significant achievements (not more than 500 words to include List of patents, publications, prototype, deployment, etc)

3. Significant results :

- a) The design of the sensors is finalised. Necessary procurement has been initiated.
- b) Materials optimisations for gas sensing have been completed.
- c) The biomarker identifications were completed after discussing them with doctors (Clinician) from the Kerala Institute of Medical Science (KIMS).
- d) The MoU is signed between the Kerala Institute of Medical Science (KIMS) and the Indian Institute of Space Science and Technology (IIST) to conduct the research.
- e) Necessary processing is going on to get the ethical clearance (Clinical trial) to conduct the research.
- f) **A prototype is developed, and it was demonstrated at the President of India in National Space Celebration, New Delhi, on 20-08-2024**
- g) **Papers:**
 - i. **Anjitha R, Palash Kumar Basu,**” Demonstrating of In₂O₃ based Methane Sensor with Minimum Baseline drift by Pre-Heating and Optical-Activation” IEEE Sensor (2024), Accepted.
 - ii. **Amala K and Palash Kumar Basu,** “Investigating the Annealing Effects of Ti₃C₂TX MXene for Stable and Selective Low-Concentration Hydrogen Detection” ACS Applied Electronics Materials (2024), accepted.

5. Concluding remarks

Since the development is initiated only in October 2022, It will take some time to publish a paper. However, the PI is more interested in applying a patent for the same and initiating a start-up.

Few Pictures:

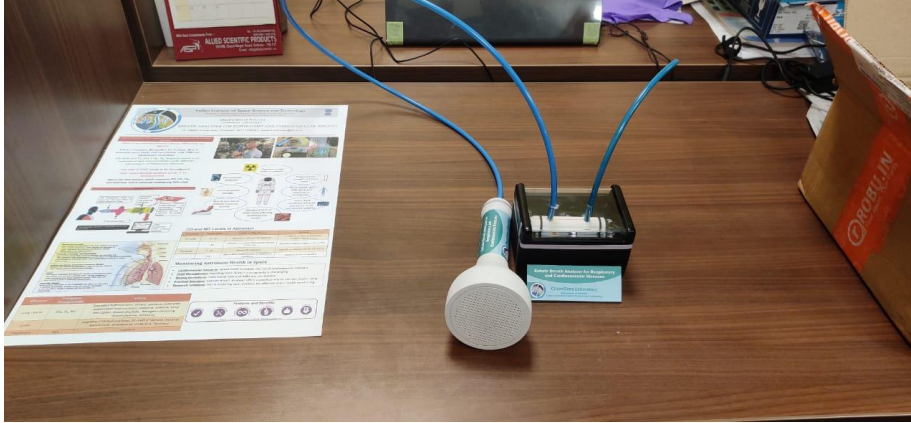


Figure 1: The Developed prototype of Breath Analyzer.



Figure 2: The prototype has been demonstrated at the President of India in National Space Celebration, New Delhi on 20-08-2024. Chairman ISRO is presenting the development.