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E-Tongue 2 REDOX Response to Heavy Metals

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Introduction

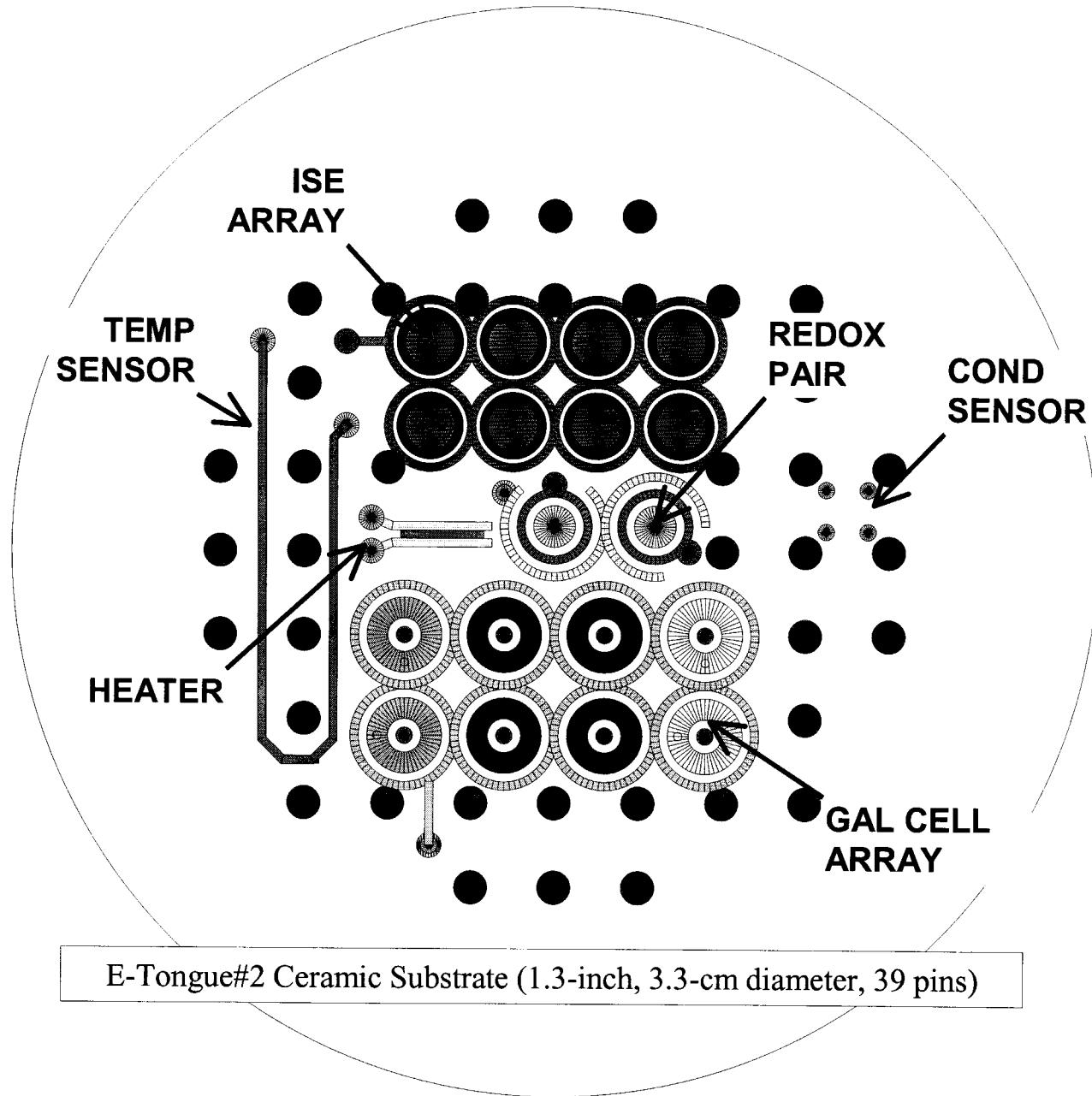
E-Tongue 2 an array of electrochemical sensors including REDOX electrodes for CV (Cyclic Voltammetry) and ASV (Anodic Stripping Voltammetry) measurements, Galvanic cells for corrosion measurements, and Ion Selective Electrodes. This paper presents recent results obtained from the REDOX electrodes used to detect Zn, Fe, and Cu in solution.

Objective: To determine water quality parameters using a multi-sensor array of planar electrodes fabricated on a ceramic substrate.

The sensor utilizes a new electrode type produced by hybrid microelectronic techniques where metal electrodes are co-fired into ceramic substrates at 900°C. This process will be described for it produces very robust electrodes that can be mounted on the periphery of sub-surface explorers to measure the electro-chemistry of soils. Initial results from REDOX electrodes indicate response peaks are well defined for Zn, Fe, and Cu. The optimum detection conditions are shown for Cu ASV response where the ASV deposition time and ASV sweep rate (V/s) are varied while keeping the analyte concentration constant.



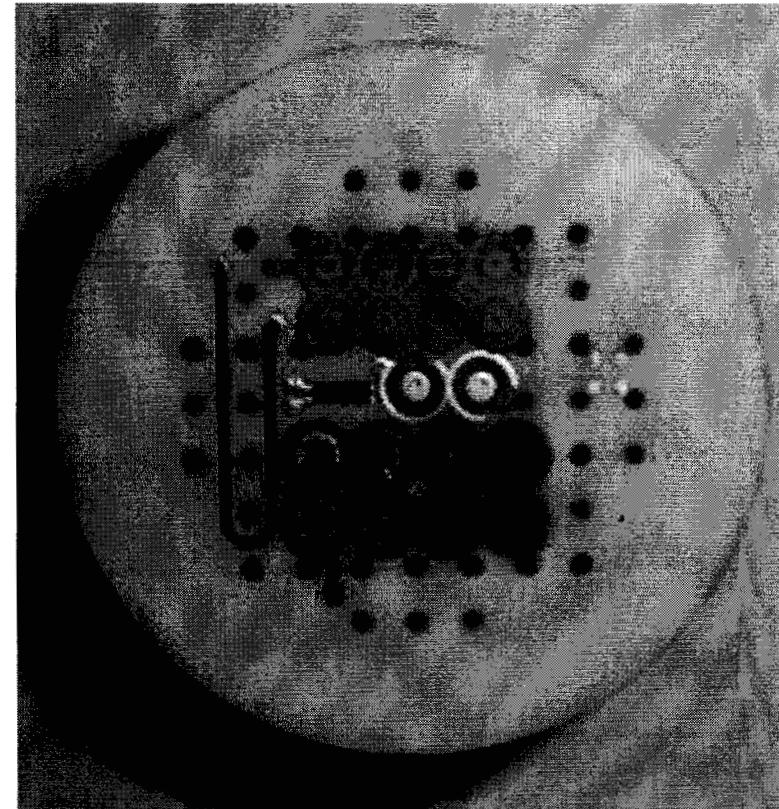
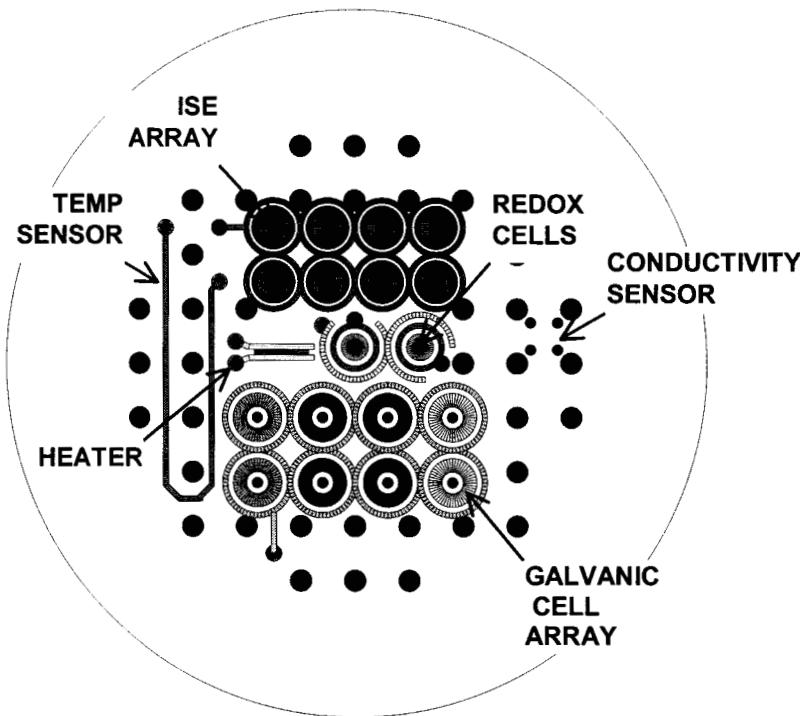
E-Tongue 2: Water Quality Monitor For ISS





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Etg2 Ceramic Substrate with Planar Electrodes



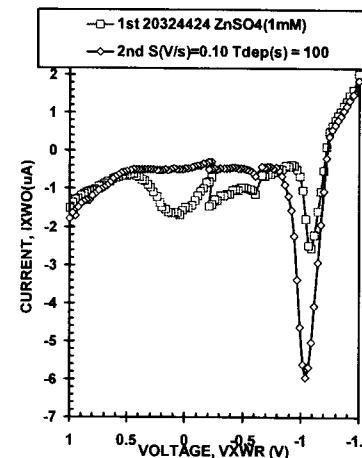
E-Tongue#2 3.3-cm diameter ceramic substrate with twelve sensors and a heater. The Galvanic Cells consist of a working electrode of Sn, Cu, Fe, and Ni surrounded by Zn electrode for corrosion analysis.



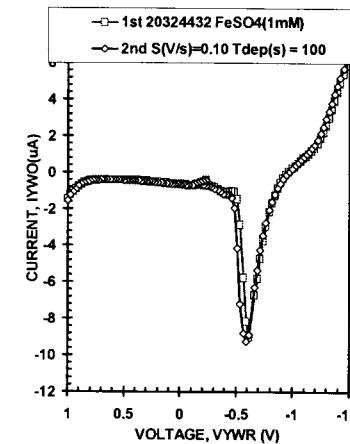
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E-Tongue 2: REDOX ASV Heavy-Metal Response

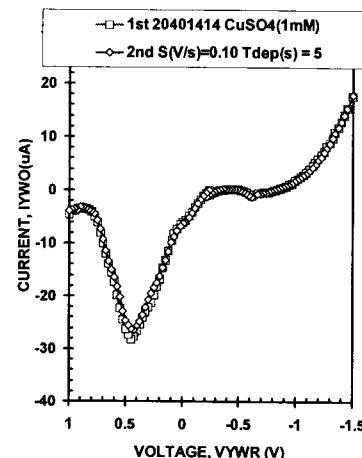
• Zn



• Fe



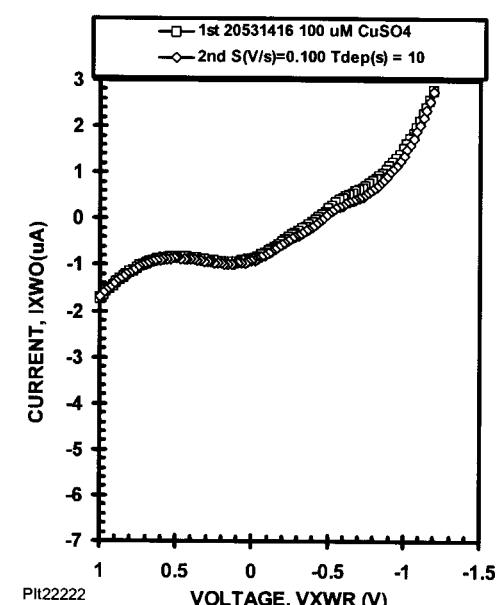
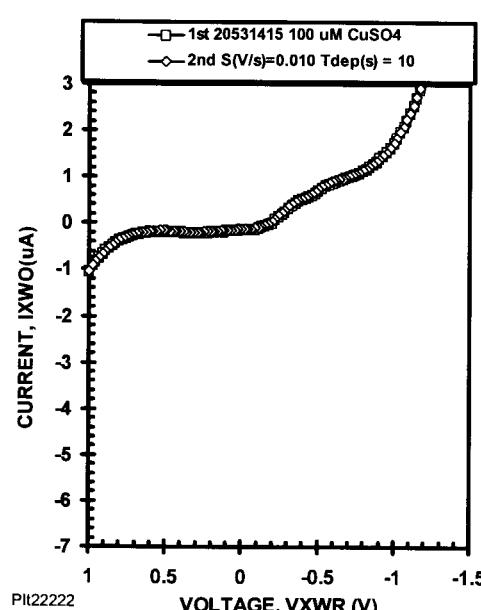
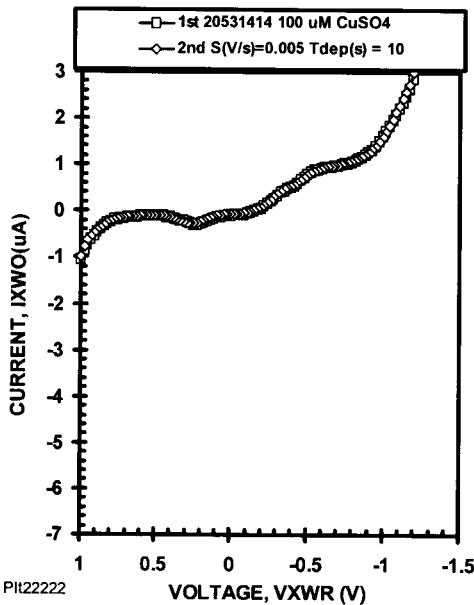
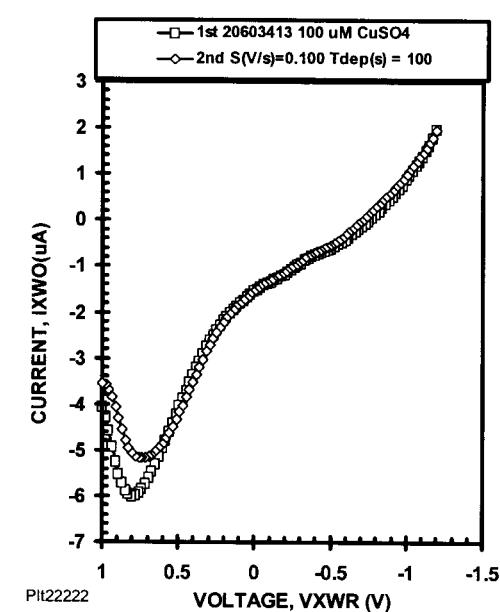
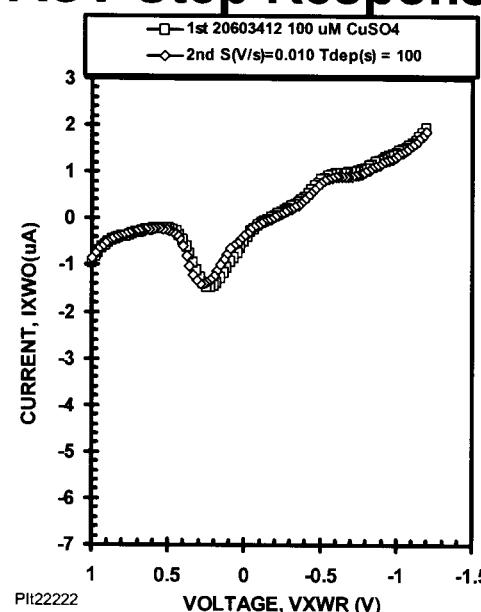
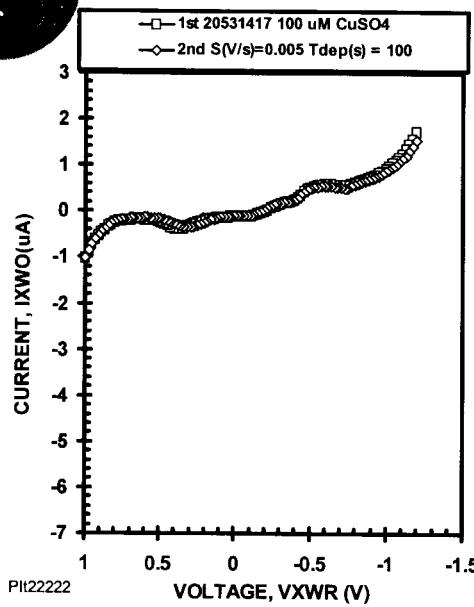
• Cu





E-Tongue 2: CuSO₄ 100 uM ASV Step Response

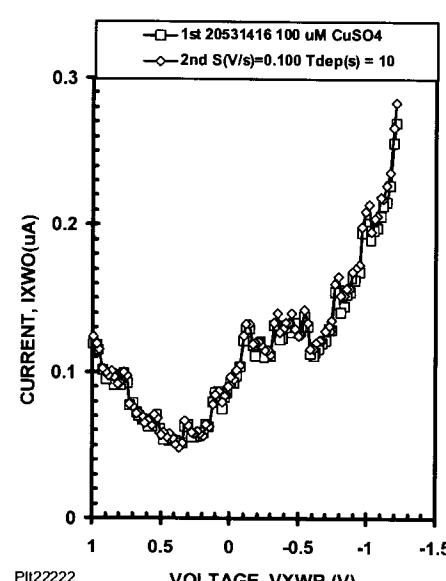
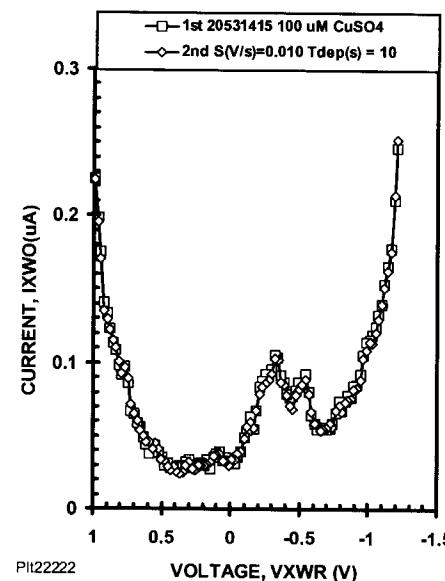
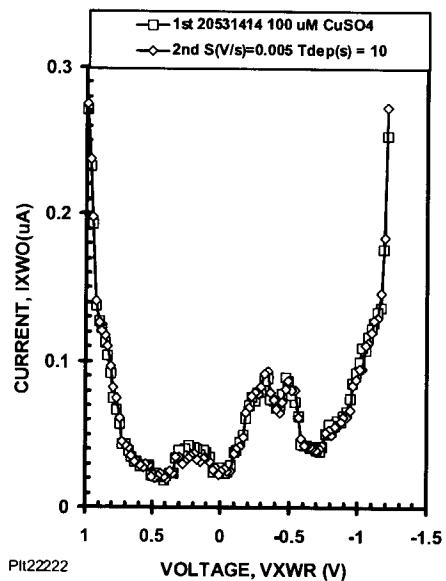
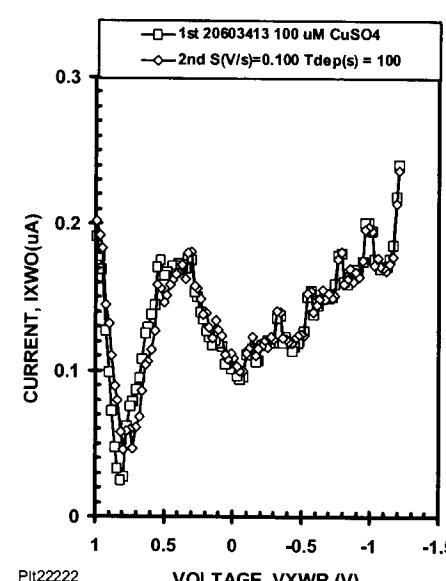
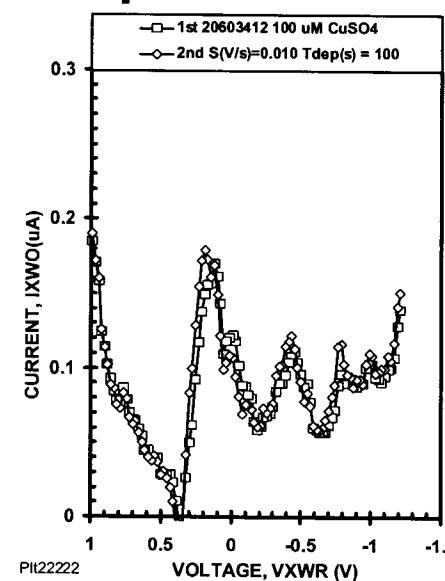
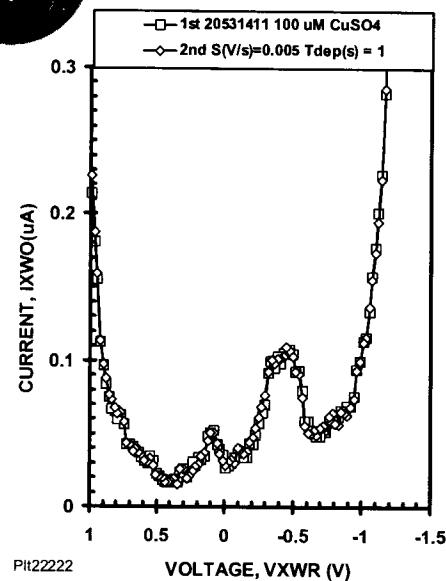
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E-Tongue 2: CuSO₄ 100 uM ASV Square Wave Response

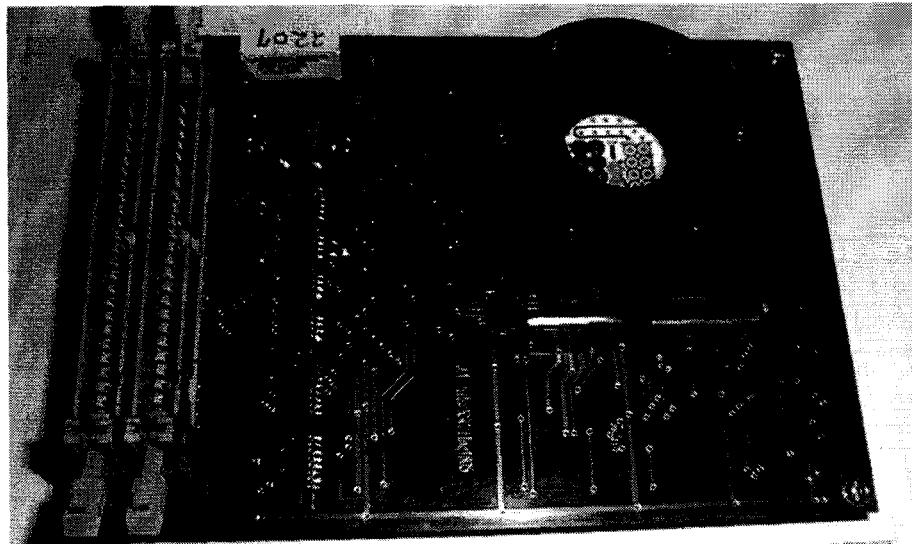
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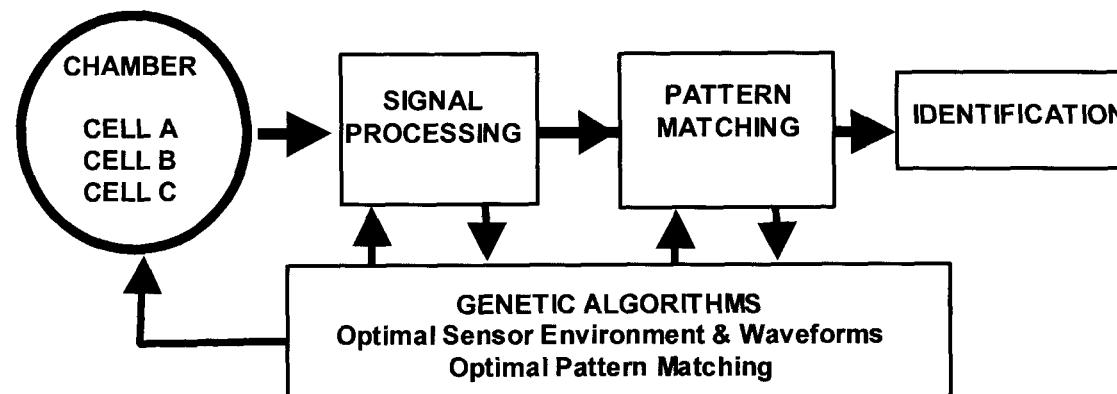


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E-Tongue 2 Apparatus and Advanced Sensor Concept



E-Tongue#2 3.3-cm diameter ceramic substrate with twelve sensors and a heater mounted on a 10-cm by 12.5 cm electronics board with on-board potentiostats and galvanostats used to control and measure the sensors.



Advanced concept used to “vector” the conditions in the chamber (pH, temperature, reagent addition) to refine the first determination to gain confidence in the answer.



Discussion

Future efforts involve:

Computerizing the measurements using pattern recognition techniques.

Use in water quality measurements. ASV measurements have been shown to have nM and sometimes pM sensitivities for the detection of metals in solution.

When developed, they can be used to gather data for cryobots, hydrobots, and sub-surface explorers.