

# Microscale Analytical Potentiometry: Experimental Teaching with Locally Produced Low-Cost Instrumentation

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**Abstract:** MicroISE, microbiosensors and microreference electrodes built with low cost locally produced materials are presented, to perform experiments to determine several analytes in instrumental analysis teaching. Creativity in experimental learning emphasizing ecological and green aspects are achieved.

**Keywords:** low cost, microISE, microbiosensors, ionic liquids

## 1. Introduction

Microscale laboratory has been widely used in General Chemistry mainly in Synthetic Chemistry (inorganic and organic chemistry). Analytical Chemistry approaches just concern to titrimetric determinations with acid — base indicators using 5 mL pipets as burets to teach semi quantitative analysis aspects. Chemical Instrumentation has been developed mainly for basic or applied research so it is difficult to access to such devices in teaching laboratories. In our laboratory, we have developed low cost equipment with locally materials to perform micropotentiometric measurements to teach Instrumental Analytical Chemistry: pH microsensors based on electro generated conductive polymers or  $W^0$  rods,  $AgCl$  or  $Ag_2S$  microcrystal with  $Ag^0$  transduction to measure chloride and sulfide anions and also microbiosensors based on fresh vegetable tissue to detect hydrogen peroxide, urea and ascorbic acid in several samples including foods, isotonic solutions and microbial systems.

## 2. Experimental Design.

### 2.1 Solid State Microsensors

The pH determination is achieved with a combined micropotentiometric system: A drawing carbon rod covered with polyaniline, PANI, obtained applying a direct potential, 9V, pulse according to Figure 1.

Microreference electrode is made by introducing a  $Cu^0$  rod in a plastic tip that contains water or a  $Cu(II)$  10 mM solution. A piece of cotton is used as liquid junction separation. The PANI electrode can be substituted by a  $W^0$  micro rod fixed in a plastic tip as well. Both pH solid-state sensor and microreference electrode are fixed in a 25 plastic vessel to performed pH measurements connected to a simple voltmeter as shown in Figure 2.

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