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LOW COST THREE-ELECTRODE POTENTIOSTAT FOR ELECTROCHEMICAL MEASUREMENTS

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The main objective of this project is to develop a low cost potetiostat to monitor redox processes where the instrument can be later optimized to meet the needs of clients from industry.The developed system consist of three main modules namely, user interface, triangular voltage generator, and current to voltage converter. User inputs of scanning voltage range and scanning rate can be input through the user interface. Triangular voltage generator consists of four sub circuits such as Atmega 328p microcontroller based 8-bit step counter, digital to analog convertor (PCF 8591 8-bit DAC), difference amplifier and inverting summing amplifier. This module outputs triangular voltage in the range of -2.5 V to +2.5 V at a user given rate where it connects to the working electrode of the three-electrode system. Current to voltage converter takes input from counter electrode of the three electrode system. The output voltage of this circuitry inputs to the microcontroller for real time data acquisition. Overall nine operational amplifiers were used to construct the proposed circuit and it is powered with 12 V DC power supply.The system constructed in this work can operate within the voltage range of -2.5 V to 2.5 V, where the user can select the desired scan rate and input parameters through a personal computer interfaced to the instrument for cyclic voltammetry. The current range measured using this system is 25 μA-2.5 mA. Performance of this system is compared with a commercially available potentiostat using $K_3Fe(CN)_6$ and $FeCl_3$ solutions. The three electrode system reported here consists of a Ag/AgCl reference electrode, a carbon working electrode, and a Pt working electrode with aqueous KCl as the electrolyte. Results are in agreement with commercially available research grade potentiostats.

Keywords: Potentiostat, Three-electrode system, cyclic voltammetry, electrochemical measurements, digital to analog conversion