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Synthesis, characterization and application of exfoliated graphite/zirconia nanocomposite electrodes for the photoelectrochemical degradation of organic dye in water

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There is a recent growing interest in the application of nanomaterials in water treatment owing to unique characteristics of materials at nano-scale, which adds value to existing technologies. Advance oxidation processes (AOP) has been shown to be a green approach to water treatment and there is a continuous quest for new materials, nanocomposites and research design concepts to bring this research niche to limelight. As a contribution to AOP, we report the synthesis and application of novel exfoliated graphite - zirconia nanocomposite as photoanodes for the photoelectrochemical degradation of methylene blue dye. In this work, ZrO_2 nanoparticle and ZrO_2 -EG nanocomposite were synthesized by sol-gel method. The materials were characterized by scanning electron microscopy (SEM/EDX), thermogravimetry and differential thermal analysis (TGA-DTA), Brunauer-Emmett-Teller surface area analysis (BET), infrared (IR) spectroscopy and X-ray diffraction (XRD). Applicability of the ZrO_2 -EG as photoanode material was investigated by the photoelectrochemical degradation of methylene blue as a model organic pollutants in 0.1 M Na_2SO_4 (pH 7) solution at a current density of 5 mA cm^{-2} after optimizing the ZrO_2 loading. The FTIR, XRD and Raman data showed the formation of the nanocomposite, shows the XRD pattern of Nano-crystalline ZrO_2 and ZrO_2 -EG nanocomposites. The XRD patterns show that the ZrO_2 nanoparticle contains both monoclinic and tetragonal phases. However, the monoclinic phase is the dominant phase and this confirms the results obtain from that of the Raman spectrum of the material. The TEM results showed the formations of nanoparticle. Photoelectrochemical studies with the ZrO_2 -EG nanocomposite showed a significant decrease in the dye concentration (20 ppm) compared with the EG only. The results indicate that the ZrO_2 nanoparticle enhanced the degradation efficiency of the EG substrate. Thus ZrO_2 -EG composite can be used for the photoelectrochemical oxidation of organic pollutants, especially organic dyes.

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Design and construction of an automatic room temperature controller

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The automatic room temperature controller is a control device that controls the temperature of a given room by switching a fan depending on the temperature level of the room. During winter period much heat in a given room is lost to the outside environment, making the room more uncomfortable for human beings and some animals. The important role played by temperature control for not only comfort of human and animal lives but also for the preservation of many other things man uses, is an essential motive for working on a special circuitry to regulate temperature levels. In tropical regions like Africa and Nigeria as an example, temperature fluctuates making it a little bit uneasy for man to live comfortably. The desire for comfort comes in the increasing development and advancement of technology brings about systems that are adversely affected by very high or low temperatures. The aim of this research is to design and construct a circuitry that can maintain or regulate the temperature of a given room within certain specified range. The design specification for a comfort providing system is intended to be the frame work for providing a comfortable environment for human beings throughout the year, in the presence of sensible heat. This is achieved by detecting the room temperature using an appropriate sensor and some controlling circuits; comparator, decoder, inverter and relays to switch ON the fan. The system switches ON the fan at 26°C temperature.

Biography

Rahila Omeji Fidelis completed her Post Graduate Diploma at the Abubakar Tafawa Balewa University, Bauchi, Nigeria. She is a registered member with the Nigerian Institute of Science Laboratory technology (Associate Member), Nigerian Society of Engineer (Associate Member), and Nigeria Association of Technologist in Engineer (Corporate Member). She is currently working with the Plateau State University, Boko as a Technologist in the Physics department.

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