ISSN 2221-6413 (Print), ISSN 2223-2559 (Online)
Coden: PJSIB5 59(1) 1-62 (2016)

Pakistan Journal of Scientific and Industrial Research

Series A: Physical Sciences

Vol. 59, No.1, January-February, 2016

(for on-line access please visit web-site http://www.pjsir.org)

Published by
Scientific Information Centre
Pakistan Council of Scientific and Industrial Research
Karachi, Pakistan

Pakistan Journal of Scientific and Industrial Research
Series A: Physical Sciences

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Preparation, Characterisation and Photocatalytic Activity of La-doped ZnO Nanopowders Synthesised using Auto-combustion

Mukhtar Ahmad[ab*], Eijaz Ahmed[a], Muhammad Ikram[a], Zhanglian Hong[b], Abdul Hafeez[c], Khalid Nadeem Riaz[d], Fezza Zafar[a], Niaz Ahmed Niaz[a] and Waqar Ahmed[ef]

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(received August 18, 2014; revised August 9, 2015; accepted August 18, 2015)

Abstract. Nanocrystalline nanoparticles of pristine ZnO and La-doped ZnO have been synthesised using a combustion method using various concentrations of lanthanum dopant followed by calcination for 3 h at 700 °C. The crystalline structure, chemical composition and optical characteristics have been characterised using X-ray diffraction (XRD), scanning electron spectroscopy (SEM) attached with energy dispersive X-ray (EDX) spectroscopy, Brunauer Emmett Teller (BET), UV-vis. spectroscopy and photoluminescence (PL) spectroscopy. Absorption spectra showed that the absorbance increased with La-doping and the blue shift observed was due to an increase in the band gap from 3.24 to 3.27 eV. The photocatalytic activities of the samples prepared were evaluated using the photocatalytic degradation of methyl orange (MO) under irradiation by sunlight. The textile mill effluents containing organic matter were also irradiated with sunlight inducing photocatalysis and the chemical oxygen demand (COD) of the treated effluent were investigated. The results showed that the ZnO photocatalyst doped with 1.0 at.% lanthanum exhibited four times enhancement in the photocatalytic activity compared to pure ZnO.

Keywords: ZnO, combustion, XRD, photocatalysis, methyl orange, La-doped ZnO

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Kinetics of Adsorptive Removal of Drimarene Brilliant Red from Aqueous Solution Using Untreated Agricultural Residues

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(received January 6, 2015; revised March 26, 2015; accepted April 2, 2015)

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Synthesis and Application of Highly Active Dithiooxamide Functionalised Multi-Walled Carbon Nanotubes Toward Mercury Removal from Aqueous Solution

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(received January 20, 2015; revised July 31, 2015; accepted August 3, 2015)

Abstract. Highly sensitive and accurate method has been applied for removal of toxic mercury(II) ions in aqueous solution, using synthesised nanosorbent. Determination of mercury(II) was carried out by flame atomic absorption spectrometer. A nanosorbent multi-walled carbon nanotubes (MWCNT) was synthesised by the reaction of dithiooxamide with functionalised multi-walled carbon nanotubes. Initially, the surface of the multi-walled carbon nanotubes was oxidised by a mixture of nitric and sulphuric acids and then was functionalised using thionyl chloride. The ligand has been attached to the multi-walled carbon nanotubes in somewhat shorter time and lower temperature than previous reported methods. The sorbent was characterised by Fourier transmission infrared and scanning electron microscopy. In this research study, the effect of different parameters in removal of mercury(II) ions by nanosorbent, such as pH, amount of nanosorbent, time and concentration of Hg(II), was investigated. Experiments show that the new MWCNT with loading amount of 1.02 mmol/g is a powerful sorbent for removing the Hg(II) ions from water.

Keywords: carbon nanotubes, mercury removal, aqueous solution, dithiooxamide

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Remote Controlling and Monitoring of Microscopic Slides

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(received December 18, 2014; revised May 11, 2015; accepted May 21, 2015)

Abstract. Remotely controlled microscopic slide was designed using especial Graphical User Interface (GUI) which interfaces the user at remote location with the real microscope using site and the user can easily view and control the slide present on the microscope's stage. Precise motors have been used to allow the movement in all the three dimensions required by a pathologist. The pathologist can easily access these slides from any remote location and so the physical presence of the pathologist is now made easy. This invention would increase the health care efficiency by reducing the time and cost of diagnosis, making it very easy to get the expert's opinion and supporting the pathologist to relocate himself for his work. The microscope is controlled with computer with an attractive Graphical User Interface (GUI), through which a pathologist can easily monitor, control and record the image of a slide. The pathologist can now do his work regardless of his location, time, cost and physically presence of lab equipment. The technology will help the specialist in viewing the patients slide from any location in the world. He would be able to monitor and control the stage. This will also help the pathological laboratories in getting opinion from senior pathologist who are present at any far location in the world. This system also reduces the life risks of the patients.

Keywords: pathology, remote monitoring, microscope, motor control, LabVIEW, Arduino, teamviewer

Pak. j. sci. ind. res. Ser. A: phys. sci. 2016 **59** (1) 34-42

Seasonal and Temporal Variations of Criteria Air Pollutants and the Influence of Meteorological Parameters on the Concentration of Pollutants in Ambient Air in Lahore, Pakistan

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(receivd September 6, 2013; revised December 19, 2014; accepted December 31, 2014)

Abstract. Criteria air pollutants have their significance for causing health threats and damage to the environment. The study was conducted to assess the seasonal and temporal variations of criteria air pollutants and evaluating the correlations of criteria air pollutants with meteorological parameters in the city of Lahore, Pakistan for a period of one year from April 2010 to March 2011. The concentrations of criteria air pollutants were determined at fixed monitoring stations equipped with HORIBA analyzers. The annual average concentrations ($\mu g/m^3$) of $PM_{2.5}$, O_3, SO_2, CO and NO_x ($NO+NO_2$) for this study period were 118.94±57.46, 46.0±24.2, 39.9±8.9, 1940±1300 and 130.9±81.0 (61.8±46.2+57.3±22.19), respectively. $PM_{2.5}$, SO_2, CO and NO_x had maximum concentrations during winter whereas O_3 had maximum concentration during summer. Minimum concentrations of $PM_{2.5}$, SO_2 and NO_x were found during monsoon as compared to other seasons due to rainfall which scavenged these pollutants. The O_3 showed positive correlation with temperature and solar radiation but negative correlation with wind speed. All other criteria air pollutants showed negative correlation with wind speed, temperature and solar radiation. A significant ($P<0.01$) correlation was found between NO_x and CO ($r = 0.779$) which showed that NO_x and CO arise from common source that could be the vehicular emission. $PM_{2.5}$ was significantly correlated ($P<0.01$) with NO_x ($r = 0.524$) and CO ($r = 0.519$), respectively. High traffic intensity and traffic jams were responsible for increased air pollutants level especially the $PM_{2.5}$, NO_x and CO.

Keywords: $PM_{2.5}$, O_3, SO_2, CO, NO_x, seasonal variations, air pollution, meteorological parameters

Pak. j. sci. ind. res. Ser. A: phys. sci. 2016 **59** (1) 43-51

Evaluation of Groundwater Quality of Selected Boreholes in Ohaozara and Ivo Council Areas of Ebonyi State, Nigeria

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(received October 13, 2014; revised January 26, 2015; accepted January 31, 2015)

Abstract. Groundwater quality in study areas was evaluated by measuring the physicochemical parameters including selected ions in water samples collected from 12 boreholes in Akaeze, Okposi and Uburu towns of Ebonyi State, Nigeria in April, 2013 and analysed using standard methods. Results obtained showed that, except for As^{5+} content, all other parameters investigated fall within WHO standards for potable water. Regression analysis showed that conductivity, SO_4^{2-} and As^{5+} levels are important variables in predicting the TDS values of the samples while NO_3^-, Cl^-, PO_4^{3-} and TDS are important in predicting the As^{5+} content of the water samples. One-way ANOVA at $P < 0.05$ showed F_{cal} (1.862) > F_{tab} (0.619), implying a significant difference between the parameters for all locations.

Keywords: borehole water, water quality, physicochemical parameters

Pak. j. sci. ind. res. Ser. A: phys. sci. 2016 **59** (1) 52-55

The Comfort of Knitted Fabric as Affected by its Structure

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(received September 2, 2014; revised February 16, 2015; accepted February 17, 2015)

Abstract. The present study was carried to investigate the effect of various knitted fabric structure on its comfort related properties. It was observed that, all comfort properties of knitted fabric have direct relation to its structure. The plain knitted fabric was found best for optimum comfort.

Keywords: air permeability, absorbency, drying time, fabric structure

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Pak. j. sci. ind. res. Ser. A: phys. sci. 2016 **59** (1) 56-59

Short Communication

An Investigation into the *In situ* Preparation of Hetero Bifunctional Monochlorotriazinyl-Vinyl Sulphone Reactive Dyes for Cotton

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(received June 3, 2014; revised March 3, 2015; accepted April 1, 2015)

Abstract. An attempt has been made in *in-situ* preparation and application of two isomers (para and meta) of aminophenyl-β-sulphatoethyl sulphone reagents (PABSES and MABSES) with three dichlorotriazinyl dyes i.e. CI Reactive Orange 86, CI Reactive Red 11 and CI Reactive Blue 168 to generate mixed hetero bifunctional dyes in dye bath. Dyeing results when compared with similar targeted type of commercially available Sumifix Supra dyes were found not up to the mark. Build up properties of all *in situ* prepared dyes were lower except for few light depth of shades as compared to preformed commercial Sumifix Supra dyes. This could be because of inefficient condensation of dichlorotriazinyl dyes with the aminophenyl-β-sulphatoethyl sulphone. However, meta isomer of aminophenyl-β-sulphatoethyl sulphone appeared to be more effective than the para isomer.

Keywords: colouration, reactive dyes, cotton, hetero bifunctional dyes, fixation

Pak. j. sci. ind. res. Ser. A: phys. sci. 2015 **59** (1) 60-62

Short Communication

Activated Sludge Process and its Suitability for Treatment of Tannery Waste Water

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(receivd April 30, 2014; revised January 1, 2015; accepted January 14, 2015)

Abstract. This study was conducted for the treatment of tannery wastewater and to develop simple design criteria under local conditions. BOD_5, COD, total Cr, SO_4^{2-}, S^{2-}, SS, TDS and TS of the influent and effluent were measured to find process efficiency at various mixed liquor volatile suspended solids (MLVSS), dissolved oxygen (DO) and hydraulic detention time. Results of the study demonstrated that an efficiency of above parameters 93.0%, 92.5%, 94.9%, 62.6%, 98.2%, 87.9%, 82.1% and 82.4%, respectively, could be obtained if the activated sludge process (ASP) is operated at the MLVSS concentration of 3500-4500 mg/L, (DO) concentration of 4.1-5.5 mg/L keeping an aeration time of 12 h.

Keywords: activated sludge, biological treatment, tannery wastewater

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