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PREFACE

The author gives thanks to Allah for bestowing His blessing and direction, allowing the **Metalurgi Journal Volume 38, Edition 1**, **2023** to be successfully published.

The first article results from Ressa Muhripah Novianti and colleagues research activities on *The Addition of C, Zn-C, and Sn-C on Anatase Titanium Dioxide (TiO_2) for Dye-Sensitized Solar Cells Application*. Norbert Egan Christo Panthoko and his colleagues presented the second article, *Synthesis of Tin Oxide Nanocrystallites with Various Calcination Temperatures using Co-Precipitation Method with Local Tin Chloride Precursor*. Lalu Suhaimi and his colleagues presented *Recovery of Manganese from Manganese Ore Reductive Acid Leaching Process using Reeds (Imperata Cylindrica) as Reducing Agent* in the following article. For the fourth article, Rizky Ramadhani Rivai and his colleagues discussed *Characterization and Analysis of Hardness, Microstructure, and Crystallography of SS 304-Sheathed MgB_2 Superconducting Wires*. The fifth article, written by Arief Dwi Rohman and his colleagues, discussed *A Preliminary Study of Cobalt Solvent Extraction from Nickel Sulphate Solution using Organic Extractant PC-88A*.

The publication of this volume in Metalurgi Journal will benefit the advancement of research in Indonesia.

EDITORIAL

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UDC (OXDCF) 621.312

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The Addition of C, Zn-C, and Sn-C on Anatase Titanium Dioxide (TiO_2) for Dye-Sensitized Solar Cells Application

DSSC (dye-sensitized solar cell) is a third-generation photovoltaic technology that can convert solar energy into electric current using a photoelectrochemical mechanism. Photoelectrode is one of the significant elements in DSSC, where photoexcited electrons are generated, and serves as an electron transport medium. Anatase titanium dioxide (TiO_2) is often used as photoelectrode material because of its excellent photoactivity, high stability, non-toxicity, environmental friendliness, and low price. Many DSSC modifications have been conducted to overcome the efficiency limitations in DSSC, and one of them is carried out by modifying the TiO_2 via doping. In this study, TiO_2 doped with C and co-doping with Zn (Zn-C) and Sn (Sn-C) were prepared using sol-gel reactions, and they were subsequently applied and tested as photoelectrode in DSSC. The results showed that undoped and doped TiO_2 had a porous spherical morphology with inhomogeneous particle sizes. The addition of C, Zn-C and Sn-C dopants has reduced in the crystallite size and the band gap energy of TiO_2. The efficiency of DSSC with undoped TiO_2 DSSC was 3.83%, while the best performance was obtained from DSSC C-TiO_2 with an efficiency of 4.20%. In contrast, the DSSC with Zn-C-TiO_2 and Sn-C-TiO_2 co-doping produced unexpectedly lower efficiency of 0.71% and 0.85%, respectively.

Keywords: DSSC (dye-sensitized solar cell), TiO_2, photoelectrode, dopant, efficiency

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Synthesis of Tin Oxide Nanocrystallites with Various Calcination Temperatures using Co-Precipitation Method with Local Tin Chloride Precursor

Indonesia is one of the largest tin metal producers in the world, and one of its derivative products is tin chloride (SnCl4). This material has been used as a raw ingredient for the production of organotin compounds such as methyltin mercaptide for PVC (polyvinyl chloride) plastic industry as a heat stabilizer. On the other hand, this precursor can be used to synthesize SnO_2 nanomaterials, which have other strategic potentials, including photocatalysts and solar cell applications. In this study, the synthesis of SnO_2 nanocrystallites was carried out using a local tin chloride precursor via the co-precipitation method, followed by a calcination process at temperatures of 300, 400, 500, and 600 °C, for further usage as an ETL (electron transport layer) in a PSC (perovskite solar cell) device. The basic properties characterization was carried out using XRD (X-ray diffraction), ultraviolet-visible (UV-Vis) spectroscopy, and SEM (scanning electron microscopy), while the photocurrent-voltage (I-V) curve photovoltaic performance of the device was performed using a semiconductor parameter analyzer. The characterization results showed that increasing the calcination temperature from 300 to 600 °C increased the average crystallite size from 1.19 to 13.75 nm and decreased the band gap energy from 3.57 to 3.10 eV. The highest PCE (power conversion efficiency) was obtained from the device fabricated with SnO_2 nanocrystallites calcined at a temperature of 300 °C, which was 0.0024%. This result was obtained due to the highest transmittance of this sample as compared to others; the higher the transmittance, the better the performance of the ETL, which in turn increased the overall efficiency of the PSC.

Keywords: SnO_2 nancrystallites, co-precipitation method, calcination temperature, electron transport layer, perovskite solar cell

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Recovery of Manganese from Manganese Ore Reductive Acid Leaching Process using Reeds (Imperata Cylindrica) as Reducing Agent

Recovery of manganese from manganese ores was investigated by reductive leaching method using reeds as a reductant in the sulfuric acid medium. Cellulose, hemicellulose, and lignin are natural reducing agents which are widely used as reducing agents to recover manganese. Effects of calcination temperature and the holding time calcination on the leaching efficiency of manganese and impurities were examined. The calcination temperature and the holding time calcination have a significant effect on the extraction of manganese. The experimental results demonstrated that the higher the calcination temperature used, the higher the percentage of manganese obtained, namely 79.58% and 87.38%, respectively. The XRD (x-ray diffraction) pattern shows that the manganese phases formed at 700 and 800 °C are Mn_3O_4 (hausmannite) and Mn_2O_3 (bixbite), respectively. The morphology in the sample with calcination temperature at 700 °C showed agglomerate-shaped particles and unevenly dispersed. Meanwhile, the sample with calcination temperature at 800 °C exhibited agglomerated particles of inhomogeneous size and were more evenly distributed. Variation of holding time in the manganese ores recovery process also affects the results of manganese recovery. The composition of the manganese recovery in the samples using holding time calcination variations of 3 and 4 hours was 83.88% and 89.24%, respectively. The results of the XRD analysis showed that the manganese phase formed using 3 hours of calcination holding time was dominated by Mn_3O_4 (hausmannite). Meanwhile, the manganese phase formed using 4 hours of holding time of calcination was dominated by Mn_2O_3 (bixbite).

Keywords: Reeds, manganese, reductant, Mn_3O_4 (haussmannite), Mn_2O_3 (bixbite)

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Metalurgi, Vol. 38, No. 1, 2023

Characterization and Analysis of Hardness, Microstructure, and Crystallography of SS 304-Sheathed MgB_2 Superconducting Wires

This research was conducted to analyze the hardness, microstructural morphology, and crystallography of the MgB_2 compound in the form of a SS 304-sheathed superconducting wire. MgB_2 superconducting wire with SS 304 outer sheath was manufactured using an ex-situ rolling process. The results of the Vickers hardness test with a load of 0.3 N showed the MgB_2 hardness value of 355.1 HV. The results of observations with SEM-EDS (scanning electron microscopy-energy dispersive spectroscopy) showed the agglomerations of the second phase of (Mg)B-O with various compositions due to the rolling process. There was also a longitudinal crack in the MgB2 area due to the work-hardening phenomenon in the brittle MgB2 solid. There were no obvious Bragg peaks in the MgB2 phase. The detected Bragg peaks came from the austenitic (□-Fe) of SS 304-sheath.

Keywords: magnesium diboride, agglomeration, FCD/TD, crystallographic texture, neutron absorption

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A Preliminary Study of Cobalt Solvent Extraction from Nickel Sulphate Solution using Organic Extractant PC-88A

In the present study, a solvent extraction experiment was done to separate cobalt from the nickel sulfate solution using 2-ethylhexyl phosphonic acid mono-2-ethylhexyl ester (PC-88A) as an extractant. The experiment was carried out on a laboratory scale using a separating funnel to extract cobalt from the nickel sulfate solution with PC-88A. The mixed solution was shaken in a separating funnel for a specified time. After the solvent extraction experiment was finished, the organic phase PC-88 was separated from the nickel sulfate solution by decantation. The nickel and cobalt content in the aqueous nickel sulfate solution was then analyzed using AAS (atomic absorption spectrophotometry). In this experiment, the variable for experiments was covering solution pH from 2 to 6, shaking time from 30 minutes to 120 minutes, shaking speed from 20 rpm (revolutions per minute) to 80 rpm, and the volume ratio of aqueous to organic phase (A:O ratio) was from 1:1 to 1:4. The effects that experimental variables to the cobalt extraction were observed in this experiment. The result of the experiment at room temperature, solution pH 5, shaking speed 60 rpm, shaking time 90 minutes, A:O ratio 1:4 and concentration of PC- 88A 40% show PC-88A can extract 97.21% of cobalt from nickel sulfate solution. Therefore, it was necessary to conduct two stage extraction process to extract 100% of the cobalt from the nickel sulfate solution.

Keywords: Solvent extraction, nickel, cobalt, nickel sulphate, PC-88A