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INNOVATION OF RENEWABLE ENERGY, CO_2 CAPTURE AND STORAGE MATERIALS FOR BETTER APPLICATIONS

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The 15th International Conference on Quality in Research (QiR) was held in Nusa Dua, Bali, Indonesia on July 24–27, 2017. The main theme was "Science, Technology and Innovation for Sustainable World." This third book of special edition of International Journal of Technology (IJTech) present 18 papers in the research areas of chemical and metallurgy & materials engineering.

The International Symposium on Chemical Engineering, QiR, covered various topics such as renewable energy business and economics, biomass conversion technologies, modeling and simulation, advanced thermal and chemical processes, waste to energy, advanced biofuel technology, catalysts, composites, photocatalysis, and adsorption. We have selected 10 papers from the 80 submitted for publication in the IJTech. The International Symposium on Materials and Metallurgy, QiR, covered topics such as carbon, graphene, oxides, nanocomposites, mesostructured materials, advanced superconducting, electrochemical water splitting, extraction, hydrometallurgy, and energy storage devices. We selected 8 papers from the 111 fullpapers for publication in the IJTech. The eighteen papers, from both symposia, are summarized below.

The first paper, written by N. Abdullah, A.A. Safana, and F. Sulaiman, present prepared biomass energy as an alternative to fossil fuel, which has become an advancing topic in recent years. Oil palm biomass, such as empty fruit bunch (EFB), mesocarp fiber (MF), and palm kernel shell (PKS) was pyrolyzed to produce bio-oil. They reported that the bio-oil produced from the pyrolysis of a torrefied sample was less acidic and contained a higher calorific value compared to bio-oil obtained from an untorrefied sample.

The second paper, written by T. Ariyanto, R.B. Cahyono, A. Vente, S. Mattheij, R. Millati, Sarto, M.J. Taherzadeh and S. Syamsiah, described a comprehensive study of the setup technology for converting fruit waste to electricity via biogas production. The waste characterization of one of the biggest fruit-waste markets showed that the three main components of the waste were orange (64%), mango (25%), and apple (5%). The rotten fruit contributes up to 80% of the total waste in the fruit market. Based on their experiment, the potential gas production from a biogas plant is approximately 1075 Nm^3/day based on 10 ton/day of fruit waste, with 54% methane.

The third paper, written by R. Desiriani, M.T.A.P Kresnowati, and I.G. Wenten, evaluated the performance of ultrafiltration (UF) and nanofiltration (NF) for separating impurities from fermentation broth; in particular, the effect of operating pressure for optimizing membrane separation and efficiently concentrating xylitol from a fermentation broth. They concluded that higher pressure resulted in a higher permeate flux; however the flow rate of the permeate flux decreased with time due to concentration polarization and fouling in the UF and NF membranes. Nevertheless, at all pressures, the UF achieved a 99% rejection of biomass cells. No biomass cells were detected in permeates after UF. The resulting nano filtration concentrates showed high xylitol retention and a beneficially lower concentration of acetic acid. The experiments achieved a reasonably high xylitol retention of >90%, which indicated negligible losses of sugar in the

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permeate port. Moreover, this configuration was proven as a feasible way to concentrate xylitol up to three times compared to the initial concentration of the modeled fermentation broth. Therefore, the results indicated that a two-stage combination of UF and NF is a promising system for the downstream processing of microbial xylitol.

The fourth paper, written by A.A. Bawono and E. Kusrini, compared the impact of different financing scenarios on natural gas supplied through pipelines to households in Indonesia using different investment scenarios ranging from the governmental, business entities, and mixed investment. From their calculations and simulations, they concluded that the government investment scenario produced the lowest gas prices, but it is a financial burden on the state. Independent investment produced high gas prices; it benefits firms but not communities. The mixed investment scenario could enhance the investment and public welfare; therefore, it is appropriate for the principles of justice and fairness and meets people's purchasing power.

The fifth paper, written by Y. Irawan, I. Juliana, I.B. Adilina and Y.F. Alli, reported the preparation of polyethylene glycol dioleate sulfonate (PDOS) surfactant solutions for enhanced oil recovery (EOR). They stated that good aqueous stability of PDOS was observed at concentrations of 0.1 to 1 wt%, while a droplet size became unstable at the lowest concentration of 0.05 wt%. The critical micelle concentration (CMC) of PDOS was 0.3% and the interfacial tension of PDOS surfactant above the CMC was around 10^{-3} dyne/cm. The zeta potential of PDOS surfactant, without the addition of salt, in concentrations of 0.05, 0.1, 0.3, 0.5, and 1 wt% was highly stable up to −96.8, −90.5, −89.6, −82.3, and −64.4 mV, respectively. However, with the addition of salt, it was moderately stable at a concentration of 1 wt%; conductivity increased with increasing concentration, whereas the zeta potential of PDOS with the addition of salt was moderately stable at a concentration of 1%. Although PDOS with a concentration of 0.05% with the addition of salt showed a high zeta potential, there is no guarantee that the PDOS surfactant solution will remain stable for five days.

The sixth paper, written by R. Roswanda, I.A Putra, and D.Mujahidin, used a Grubbs II™ catalyst for the reaction of olefin metathesis on methyl oleate. They found that the internal olefin metathesis reaction of methyl oleate produced dimethyl 9-oktadecendioate and 9-octadecene in the presence of ruthenium Grubbs II catalyst with 51% yields. They also found that the amount of E-isomer product was higher than Z-isomer product.

The seventh paper, written by S. Kartohardjono, A. Paramitha, A.A. Putri, and R. Andriant, described the utilization of super hydrophobic hollow fiber membrane contactor as a gas-liquid contactor to absorb CO_2 from a mixture with CH_4 using polyethyl eneglycol-300 (PEG-300) as the absorbent. They concluded that the mass transfer coefficient, the flux, and the absorption efficiency increased with absorbent flow rate, but decreased for CO_2 loading. The absorption efficiency and the CO_2 loading increased with the number of fibers in the contactor, whilst the absorption efficiency and the CO_2 loading decreased.

The eighth paper, written by E. Kusrini, A.K. Sasongko, Nasruddin, and A. Usman, described the development a new carbon dioxide (CO_2) adsorbent based on graphite waste modified by magnetite nanoparticles, Fe_3O_4. The CO_2 adsorption performance was evaluated using the isothermal adsorption method with a volumetric principle at various temperatures (30°C, 35°C, and 45°C) and pressures of (3, 5, 8, 15, and 20 bar). They reported that graphite produced with different magnetite modification levels, namely non-modified graphite (GNM), graphite/Fe_3O_4 20% (w/w) (G/Fe_3O_4 20%), and graphite/Fe_3O_4 35% (w/w) (G/Fe_3O_4 35%) composites, produced the largest adsorption capacity of10.305 mmol.g^{-1}at 30°C and 20 bar with the G/Fe_3O_4 20% composite. The findings further indicate that modifying graphite waste with magnetite nanoparticles, Fe_3O_4, increases the adsorption capacity for CO_2 gas.

The ninth paper, written by A. Fadli, A. Amri, E.O. Sari, Iwantono, and A. Adnan, reported obtaining biocompatible super paramagnetic magnetite nanoparticles with controlled size and morphology, that meet the criteria applied to drug delivery. The magnetite began to form after three hours of synthesis, and the crystallinity and crystal size of the magnetite increased with reaction time. The diameter of the magnetite crystals was in the range of 10–29 nm, and the magnetite nanoparticles were of relatively uniform size and non-agglomerated. Core-shell nanoparticles were obtained after three hours of synthesis with a diameter of 60 nm, whereas irregular-shaped nanoparticles were obtained after12 hours, with diameters of 50 nm. The magnetite nanoparticles had super paramagnetic properties. The magnetization saturation (Ms) value was proportional to the degree of crystallinity. The magnetite crystal-growth data could be fitted to an Ostwald ripening growth model with growth controlled by the dissolution of the surface reaction ($n \approx 4$).

The tenth paper, written by A. Wijanarko, D.F. Nur, M. Sahlan, N.T. Afnab, T.S. Utami, and H. Hermansyah, reported the preparation of an organic pesticide from acysteine protease extract from papaya latex against *Spodoptera litura*. They reported that the crude papain extract's protease activity assay was highest when using the rind of the papaya and the blending method. An odor test showed that crude papain extract was best stored at10°C. The protease activity of the papain extract reached up to 98 ppm. Because of the high protease activity, the papain extract was stored at 37°C. An efficacy test demonstrated that the papain extract was powerful enough to kill *S.litura*, especially in wet conditions.

The eleventh paper, written by R. Winantyo and K. Murakami, investigated the formation of ZnO-nanorod, used for dye sensitized solar cell applications. Different morphologies of zinc oxide (ZnO) can be obtained using various synthesizing methods, such as a water bath. By synthesizing under various conditions, different ZnO morphologies can be obtained using the water bath method. Replacing ZnO nanoparticles with vertically aligned ZnO nanorods showed much higher energy conversion efficiency; however, vertically aligned nanorods are difficult to grow and can be an expensive method. In this work, vertically aligned nanorods with an optimum size ratio were formed using a simple water bath method. This method demonstrated that the ZnO nanorods were well aligned and grew with high density and uniformity on the substrate. X-ray diffraction patterns showed that the nanorods grew in the (001) direction. The density, diameter, and length of the ZnO nanorods could be altered by changing the growth conditions. The results demonstrated that the morphology and alignment of ZnO nanorods are determined by the precursor type and deposition time.

The twelfth paper, written by C.P. Supriadi, E. Kartini, W. Honggowiranto, and K.T. Basuki, examined the synthesis and characterization of carbon material obtained using hydrothermal heating and pyrolysis of coconut coir dust (CCD). In this article, CCD was used as the carbon precursor to provide an intermediate-product for further graphene production. In this process, CCD, sieved through100 mesh, was carbonized using a hydrothermal method at 235°C, 250°C, and 265°C for 4 hours. The solid residue obtained was further pyrolyzed at 1,000°C for 2 hours under nitrogen. The XRD pattern showed two broad peaks centered around $2\theta \approx 24°$ and 44°,corresponding to the (002) and (100) graphite planes. This pattern has a similarity to that of reduced-graphene oxide. Scanning electron microscope (SEM) images showed a sheet-like microstructure resulting from undegraded lignin. The perforated and corrugated sheet formed after pyrolysis confirmed the formation of reduced-graphene oxide. The Raman result indicated that higher hydrothermal temperature leads to an increasing integrated ID/IG ratio. The ratio was 1.62, 1.71, and 1.77 for pyrolysis temperatures of 235°C, 250°C, and 265°C, respectively. It was concluded that the carbonaceous material formed through subsequent hydrothermal and pyrolysis processes contained a mixture of amorphous-carbon and graphene-like clusters.

The thirteenth paper, written by V. Rizkia, J.W. Soedarsono, B. Munir, and B. Suharno, analyzed the effect of electrolyte resistivity on the pore diameter and pore density of anodic aluminum oxide (AAO) films produced by single-step anodization. In this article, nanoporous AAO layers were successfully fabricated on aluminum foil by an anodizing process in oxalic acid and mixed electrolytes of sulfuric and oxalic acid. The effect of electrolyte resistivity on the morphology of the nanoporous AAO such as pore diameter and pore density was reported. The results showed that anodizing in mixed electrolytes (sulfuric and oxalic acid) produced much smaller pore diameter and much higher pore density at lower voltages compared to anodizing in a single oxalic acid. The pore diameters ranged from 14 to 52 nm and pore density was 34–106 pores/500×500 nm^2 for the anodizing process in oxalic acid. The anodizing process in the mixed electrolytes resulted in pore diameters inthe range of 7–14 nm and pore densities within the range of 211–779 pores/500×500 nm^2. Overall, increasing electrolyte resistivity within the same solution leads to decreasing pore diameter.

The fourteenth paper, written by D. Dhaneswara, R.N. Verdiyanto, and A.Z. Syahrial, examined the mechanical properties of Al_2O_3-reinforced aluminum, A356, with a grain refiner, Al-5Ti-1B, fabricated using the stir casting method. This study aimed to develop a composite material consisting of aluminum A356 as the matrix, micro Al_2O_3 as a reinforcement, and 8 wt% magnesium as a wetting agent, with the addition of 0.0, 0.01, 0.0347, 0.0362, 0.0622, and 0.0689 wt% of the grain refiner, TiB, using the stir casting method. The results showed that the addition of 0.0347 wt% TiB reduced the size and changed the shape of a long and coarse grain to around and fine grain that increased tensile strength, hardness, and wear resistance significantly, but decreased elongation and ductility.

The fifteenth paper, written by I.D.G.A. Subagia, I.K.G. Sugita, I.K.G. Wirawan, N.M. Dwidiani, and A.H. Yuwono, explained the thermal conductivity of a carbon/basalt fiber reinforced epoxy hybrid composite. The hybrid composite was processed with an injection mold. The weight ratio of fiber to polymer was 60:40. The results showed that the stacking sequences of carbon/basalt fibers have significant impact on thermal conductivity. Hybrid composites with a stacking sequence mode of $C_3B_4C_3$ had the lowest thermal conductivity of 0.187 W/mK and the highest thermal impedance of 0.0052 m^2K/W. The highest thermal impedance of basalt fiber reinforced polymer (BFRP) was at 0.007 m^2K/W with a thickness of 2.5 mm. For carbon fiber reinforced polymer (CFRP), the highest thermal impedance was achieved with a thickness of 3.4 mm and 0.005 m^2K/W. Therefore, the carbon/basalt/epoxy hybrid composite was a good insulator because the thermal conductivity was smaller than the 0.42 W/m°K standard.

The sixteenth paper, written by H Aripin, I.M. Joni, S. Mitsudo, I.N. Sudiana, E. Priatna, N. Busaeri, and S. Sabchevski, discussed the formation and particle growth of TiO_2 on silica xerogel glass-ceramic during a sintering process. The article presented the synthesis procedure and the results of an investigation of the crystallite growth of TiO_2 and the formation of Si–O–Ti bonds in novel silica xerogel (SiO_2) glass-ceramic produced from sago waste ash. The composite was prepared by adding 20–80 wt% of TiO_2 into the amorphous SiO_2 and stirring at 1,200°C for 2 hours. The influence of the TiO_2 and the sintering temperature on the properties of Si–O–Ti was studied in detail. The results showed that the addition of SiO_2 confers an appreciable effect on the quantity of Si–O–Ti bonds produced.

The seventeenth paper, written by H. Jodi, A.Z. Syahrial, Sudaryanto, and E. Kartini, examined the synthesis and electrochemical characterization of new Li_2O-P_2O_5 compounds for solid electrolytes. The solid electrolyte is very interesting because of its potential application in a wide variety of electrochemical devices. One of the most stable solid electrolytes is Li_3PO; however, its conductivity is too low for its application as an electrolyte. In this paper, new compositions of the Li_2O-P_2O_5 compounds were prepared using solid-state reactions. The XRD characterization

showed that both of the samples were composed mainly of $Li_4P_2O_7$ crystals. Agglomeration of the particles was observed in the samples. The conductivity was in the order of 10^{-6} S/cm, which is higher by three orders of magnitude than Li_3PO_4. The evaluated power exponent of conductivity indicated that the long-range drift of ions might be one of the sources of ion conduction in both the observed samples. The nature of the dielectric loss indicated that the conduction in the samples was more predominantly DC conduction.

The eighteenth paper, written by Masruroh, M.A. Hanif, S.P. Sakti, and D.J.D.H. Santjojo, investigated plasma power effects on the surfaces of quartz crystals during etching using tetra fluoro ethane gas. The performance of a quartz crystal microbalance (QCM) biosensor can be enhanced by patterning the surface of the SiO_2 substrate. In this article, the patterning was realized using tetra fluoro ethane (CH_2FCF_3) plasma generated from a 40 kHz generator. The specimens were produced using 40–120 w for 1 hour. The results showed that the highest etching rate, 17.90 nm/min, was obtained by applying a plasma power of 100 w. The rate relatively indicated a slow etching process due to a complex mixture of fluor (F) and CH_2FCF_2 compound. This slow etching rate is preferable for controlling the pattern's nanoprofiles. The applied power also affected the anisotropy of the etched profile, and the best anisotropic coefficient, 4.8×10^{-2}, was obtained with optimized 110 w power. The anisotropy was defined as the ratio of the vertical etching rate to the horizontal etching rate. This ratio is important for determining the quality of the patterned QCM profile.

We hope this special edition of IJTech provides useful information and knowledge, and we invite you to join us in this journal by sending your research paper for our consideration.

With warmest regards from Jakarta,

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