บทความที่น่าสนใจประจำเดือนมีนาคม 2556

1. Optimizing the synthesis of carbon nanofiber based electrocatalysts for fuel cells

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วารสาร: Applied Catalysis B: Environmental, Volumes 132–133, 27 March 2013, Pages 22–27

Abstract: This work deals with an optimization of the platinum dispersion on low surface area carbon nanofibers (CNFs) by using different synthesis procedures and its electrocatalytic activity toward oxygen reduction. The selected CNFs were characterized by a BET surface area of ca. 100 m^2 g^{-1} and were in-house synthesized by the decomposition of CH_4 at 700 °C. Pt nanoparticles were deposited by using four different synthesis routes. A metal concentration of 20 wt% was confirmed by EDX and TGA. Two classical impregnation routes were employed, one using $NaBH_4$ as reducing agent at 15 °C and the second one using formic acid at 80 °C. Two alternative processes consisted in a microemulsion procedure followed by reduction with $NaBH_4$ and a colloidal route by using the sulphite complex method followed by reduction with hydrogen. The main differences regarded the platinum crystal size varying from 2.5 nm for the colloidal route to 8.1 nm for the impregnation route (formic acid). The classical impregnation procedures did not result appropriate to obtain a small particle size in the presence of this support, whereas microemulsion and colloidal methods fit the requirements for the cathodic oxygen reduction reaction in polymer electrolyte fuel cells, despite the low surface area of CNFs. The catalysts were subjected to an accelerated degradation test by continuous potential cycling. Although the initial activity was the highest for the microemulsion based catalyst, after the accelerated degradation test the colloidal based catalyst experienced a relatively lower loss of performance.

2. Water splitting from dye wastewater: A case study of BiOCl/copper(II) phthalocyanine composite photocatalyst

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วารสาร: Applied Catalysis B: Environmental, Volumes 132–133, 27 March 2013, Pages 315–320

Abstract: Oxygen evolution is frequently the bottleneck determining the efficiency in the overall photocatalytic water splitting. Herein, for the first time overall water splitting reaction to H_2 and O_2 is realized on BiOCl/CuPc (copper phthalocyanine) composite from RhB (rhodamine B) solution under simulated solar light irradiation. The photosensitized RhB dye molecules supplied photo-generated holes which took part in the reaction of O_2 evolution. By loading CuPc, the efficiency of H_2 evolution is improved. On the base of the greatly enhanced photocurrent density, the considerable enhancement of performance can be attributed to the quick transfer of photogenerated electrons from the photosensitizer to the CB (conduction band) of BiOCl. Furthermore, as active electron traps, the oxygen vacancies on the surface of the BiOCl photocatalyst promote the separation efficiency of photo-generated electrons and holes, resulting in high photoactivity. This study presents a way that organic dye wastewater will be a useful system for the overall photocatalytic water splitting reaction to H_2 and O_2.

3. A novel twin reactor for CO_2 photoreduction to mimic artificial photosynthesis

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วารสาร: Applied Catalysis B: Environmental, Volumes 132–133, 27 March 2013, Pages 445–451

Abstract: One of the best routes to covert CO_2 into energy and simultaneously reduce atmospheric CO_2 is photosynthesis. In natural photosynthesis, the first step is water splitting in which proton is generated and O_2 is released using solar energy. The second step is the Calvin cycle in which CO_2 is reduced to hydrocarbons. This study demonstrated the photocatalytic hydrogenation of CO_2 by using a novel twin reactor to mimic photosynthesis process in nature. The twin reactor, which divided H_2-generating photocatalyst and O_2-generating photocatalyst in two compartments using a membrane, first achieved separate H_2 and O_2 evolution to prevent the backward reaction to form water under visible light irradiation. The generated hydrogen was then used to perform CO_2 hydrogenation by CO_2 reduction photocatalyst. The advantage is that CO_2 hydrogenation is a spontaneous reaction based on the thermodynamics. The single photocatalyst system using Pt/$CuAlGaO_4$ as both H_2-generating photocatalyst and CO_2 reduction photocatalyst, was compared with the dual photocatalyst system using Pt/$SrTiO_3$:Rh and Pt/$CuAlGaO_4$ as H_2-generating photocatalyst and CO_2 reduction photocatalyst, respectively, under simulated sunlight AM1.5G. The dual photocatalyst system has demonstrated photoreduction quantum efficiency (PQE) of 0.0051%, which is more than doubled the PQE of the single photocatalyst system.

4. The chiral triazole fungicide difenoconazole: absolute stereochemistry, stereoselective bioactivity, aquatic toxicity and environmental behavior in vegetables and soil

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วารสาร: Environmental Science & Technology, Just Accepted Manuscript, Publication Date (Web): March 1, 2013

Abstract: In this study, the systemic assessments of the stereoisomers of triazole fungicide difenoconazole are reported for the first time, including absolute stereochemistry, stereoselective bioactivity towards pathogens (Alternaria sonali, Fulvia fulva, Botrytis cinerea and Rhizoctonia solani), and toxicity towards aquatic organisms (Scenedesmus obliquus, Daphnia magna and Danio rerio). Moreover, the stereoselective degradation of difenoconazole in vegetables (cucumber, Cucumis sativus and tomato, Lycopersicon esculentum) under field conditions and in soil under laboratory-controlled conditions (aerobic and anaerobic) was investigated. There were 1.33–24.2-fold and 1.04–6.78-fold differences in bioactivity and toxicity, respectively. Investigations on the stereoselective degradation of difenoconazole in vegetables showed that the highest-toxic and lowest-bioactive (2S,4S)-stereoisomer displays a different enrichment behavior in different plant species. Under aerobic or anaerobic conditions, (2R,4R)- and (2R,4S)-difenoconazole were preferentially degraded in the soil. Moreover, difenoconazole was configurationally stable in the test soil matrices. Based on biological activity, ecotoxicity, and environmental behavior, it is likely that the use of pure (2R,4S)-difenoconazole instead of the commercial stereoisomer mix may help to increase the bioactivity and reduce environmental pollution.

5. Finding Synergies in Fuels Properties for the Design of Renewable Fuels - Hydroxylated Biodiesel Effects on Butanol-Diesel Blends

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วารสาร: Environmental Science & Technology, Just Accepted Manuscript, Publication Date (Web): March 1, 2013

Abstract: This paper describes the effects of hydroxylated biodiesel (castor oil methyl ester – COME) on the properties, combustion and emissions of butanol-diesel blends used within compression ignition engines. The study was conducted to investigate the influence of COME as a means of increasing the butanol concentration in a stable butanol-diesel blend. Tests were compared with baseline experiments using rape methyl esters (RME). A clear benefit in terms of the trade-off between NOX and soot emissions with respect to ULSD and biodiesel-diesel blends with the same oxygen content was obtained from the combination of biodiesel and butanol, while there was no penalty in regulated gaseous carbonaceous emissions. From the comparison between the biodiesel fuels used in this work, COME improved some of the properties (for example lubricity, density and viscosity) of butanol-diesel blends with respect to RME. The existence of hydroxyl group in COME also reduced further soot emissions and decreased soot activation energy.

6. A Lumped Pathway Metabolic Model of Organic Carbon Accumulation and Mobilization by the Alga Chlamydomonas reinhardtii

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วารสาร: Environmental Science & Technology, Just Accepted Manuscript, Publication Date (Web): March 1, 2013

Abstract: Phototrophic microorganisms have significant potential as bioenergy feedstocks, but the sustainability of large-scale cultivation will require the use of wastewater as a renewable resource. A key barrier to this advancement is a lack of bioprocess understanding that would enable the design and implementation of efficient and resilient mixed community, naturally-lit cultivation systems. In this study, a lumped pathway metabolic model (denoted the phototrophic process model, or PPM) was developed for mixed phototrophic communities subjected to day/night cycling. State variables included functional biomass (XCPO), stored carbohydrates (XCH), stored lipids (XLI), nitrate (SNO), phosphate (SP), and others. PPM metabolic reactions and stoichiometry were based on Chlamydomonas reinhardtii, but experiments for model calibration and validation were performed in flat panel PBRs originally inoculated with biomass from a phototrophic system at a wastewater treatment plant. PBRs were operated continuously as cyclostats to poise cells for intrinsic kinetic parameter estimation in batch studies, which included nutrient-available conditions in light and dark as well as nitrogen-starved and phosphorus-starved conditions in light. The model was calibrated and validated and was shown to be a reasonable predictor of growth, lipid and carbohydrate storage, and lipid and carbohydrate mobilization by a mixed microbial community.

7. Densities of the carbon dioxide + hydrogen, a system of relevance to carbon capture and storage

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วารสาร: International Journal of Greenhouse Gas Control, Volume 13, March 2013, Pages 78–86

Abstract: The densities of the carbon dioxide (CO_2) and hydrogen (H_2) mixtures (xH_2=0.020,0.075 and 0.100) have been determined at six temperatures from 288.15 to 333.15 K and pressures up to 23.0 MPa using a high-pressure vibrating-tube densitometer. The experimental temperatures and pressures cover a range of sub- and supercritical conditions, providing essential information for the optimum design and operation of compressors and pipeline networks in carbon capture and storage (CCS). It was found that a concentration of H_2 as low as 2% could lower the density by as much as 25% compared to pure CO_2. The data were used to calculate the excess molar volumes, showing highly non-ideal mixing behaviour of the binary system of CO_2 + H_2. The new density data were also compared to those predicted using the GERG-2004 equation of state (Kunz, O. et al., 2007. The GERG-2004. Wide-range equation of state for natural gases and other mixtures, Düsseldorf). The deviations between the calculated and experimental data are 0.6%, 1.7% and 1.8%, respectively, for the mixtures with xH_2=0.020,0.075 and 0.100. These results suggest that the GERG-2004 equation of state has the potential for accurate prediction of the volumetric property of CO_2 mixtures containing H_2 in the CCS processes, and further parameterisation of GERG-2004 or development of new equations of state specifically tailored for CCS mixtures is required.

8. Influence of climate change mitigation technology on global demands of water for electricity generation

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วารสาร: International Journal of Greenhouse Gas Control, Volume 13, March 2013, Pages 112–123

Abstract: Globally, electricity generation accounts for a large and potentially growing water demand, and as such is an important component to assessments of global and regional water scarcity. However, the current suite—as well as potential future suite—of thermoelectric generation technologies has a very wide range of water demand intensities, spanning two orders of magnitude. As such, the evolution of the generation mix is important for the future water demands of the sector. This study uses GCAM, an integrated assessment model, to analyze the global electric sector's water demands in three futures of climate change mitigation policy and two technology strategies. We find that despite five- to seven-fold expansion of the electric sector as a whole from 2005 to 2095, global electric sector water withdrawals remain relatively stable, due to the retirement of existing power plants with water-intensive once-through flow cooling systems. In the scenarios examined here, climate policies lead to the large-scale deployment of advanced, low-emissions technologies such as carbon dioxide capture and storage (CCS), concentrating solar power, and engineered geothermal systems. In particular, we find that the large-scale deployment of CCS technologies does not increase long-term water consumption from hydrocarbon-fueled power generation as compared with a no-policy scenario without CCS. Moreover, in sensitivity scenarios where low-emissions electricity technologies are required to use dry cooling systems, we find that the consequent additional costs and efficiency reductions do not limit the utility of these technologies in achieving cost-effective whole-system emissions mitigation.

9. Waste lubricating oil treatment by extraction and adsorption

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วารสาร: Chemical Engineering Journal, Volume 220, 15 March 2013, Pages 343–351

Abstract: In this work, the recovery of base oils from waste lubricants was investigated using a novel combination of solvent extraction and adsorption on solids. The performance of six extracting solvents (*n*-hexane, 1-butanol, petroleum ether, 1-hexanol, carbon tetra chloride, and acetone) was evaluated experimentally. Solvent to oil ratios from 1:1 to 4:1 were also examined. This research has studied the effect of the use of KOH to enhance flocculation. The results show that 1-butanol achieved the best performance with the maximum percent sludge removal, followed by n-hexane, petroleum ether, 1-hexanol, carbon tetrachloride, and acetone. The percentage of oil sludge was found to increase with the increase of solvent to oil ratio until it reached the maximum at the ratio of 3:1. The application of an adsorption process using different adsorbent materials was investigated. Adsorbent materials such as almond shell, walnut shell, eggshell, and acid activated clay which were prepared locally were used. It was found that the acid activated clay was able to give the best conditions for treating the waste oil followed by the almond shell powder. The results from the test showed that, viscosity increased from 38.3 cst for used lube oil to 85 cst for acid/clay treatment and the flash point increase from 178 °C to 238 °C, while the density decreased from 912 to 896 kg/m^3, the pour point from −6 to −13.2 °C and colour from 0.53 to 0.12. Other results from the different tests showed varying degrees of improvement with the best results obtained using the acid/clay treatment.

10. The potential of using cocoa pod husks as green solid base catalysts for the transesterification of soybean oil into biodiesel: Effects of biodiesel on engine performance

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วารสาร: Chemical Engineering Journal, Volume 220, 15 March 2013, Pages 395–401

Abstract: In this study, the feasibility of using potash from cocoa pod husks (CPHs) in the transesterification of soybean oil into biodiesel was investigated. Both supported (CPH/MgO) and unsupported (CPH ash) catalysts of potash prepared from CPH were used as green heterogeneous catalysts for biodiesel production. Under optimum conditions for the CPH/MgO-catalyzed (oil/methanol ratio of 1:6, 60 °C, 60 min, 1 wt.% of MgO doped CPH ash catalyst) and the CPH-catalyzed (60 °C, oil/methanol ratio of 1:6, 120 min, 1 wt.% of CPH ash) transesterification reactions, biodiesel samples (98.7% and 91.4% yields for CPH/MgO and CPH ash catalysts respectively) with specifications falling within the limits of the European biodiesel quality standard (EN 14112) were obtained. Brake thermal efficiencies and torque were measured for each fuel sample at different loads. Engine test showed a better performance for all the fuel samples (B100 and B40) with B40 showing close characteristics of petroleum diesel. Thus, this first report on the utilization of CPH as catalyst for biodiesel shows a high feasibility of producing green heterogeneous base catalysts commercially from CPH for sustainable biodiesel production.