Editor's Choice

Editor's Choice
Korean Journal of Chemical Engineering,
Vol.34, No.5, 1281-1293, 2017

Interfacial phenomena between conjugated organic molecules and noble metals

Kim JH

Abstract - Understanding interfacial interaction between conjugated organic molecules and noble metals is important not only for surface science, but also in relation to organic epitaxy, the architecture of intermolecular networks or nanostructures, and organic electronics. Particularly, properties of interfacial geometric and electronic structures and their related phenomena have attracted much interest for their potential in various electronic and optoelectronic applications, and thus extensive efforts have been devoted to understand and control organic/metal interfaces. We provide an overview of interfacial phenomena between conjugated organic molecules and noble metals via various interactions at the organic/metal interfaces such as surface-molecule and intermolecular interactions, as well as recent progress achieved in this area.

Korean Journal of Chemical Engineering,
Vol.34, No.5, 1305-1309, 2017

Controlled release of iron for activation of persulfate to oxidize orange G using iron anode

Jeon P, Park SM, Baek K

Abstract - Persulfate (PS) can be activated by transition metal to generate a sulfate radical and oxidize persistent organic pollutants. However, activation with excessive Fe(II) causes unnecessary self-degradation of PS. In this study, Fe(II) was slowly and continuously injected electrochemically using an iron anode to minimize the self-degradation of PS. Additionally, reaction rate was controlled by adjusting the current intensity applied to the system. Total organic carbon (TOC) was analyzed as an indicator of complete mineralization because the model pollutant, orange G (OG), produced secondary pollutants after disruption of the azo bonds. The removal rate of TOC was 1/10-th of that for OG. In addition, the effect of molar ratio of OG and PS was also studied to confirm the complete mineralization of OG.

Korean Journal of Chemical Engineering,
Vol.34, No.5, 1319-1327, 2017

Nanoparticle deposition in transient gaseous microchannel flow considering hindered motion and rarefaction effect

Andarwa S, Tabrizi HB

Abstract - Interaction between wall and flow becomes more important when the scale of a channel decreases. We investigated two effects of wall presence for the transport of nanoparticle in a microchannel, which are the rarefaction effect up to early transient regime and hindered motion of nanoparticles. Lattice Boltzmann method coupled with Lagrangian nanoparticle tracking was used for modeling. Series of numerical simulation for various nanoparticle diameters, channel geometries, fluid velocities, and Knudsen numbers were performed. Some important features on nanoparticle transport such as capture efficiency, deposition velocity and deposition location were discussed. Using suitable dimensionless parameters, correlations for capture efficiency and deposition velocity were obtained. Considering hindered motion leads to significant decrease in the capture efficiency and deposition velocity. Results show that the effect of rarefaction on deposition is mostly because of varying the force acting on nanoparticles not due to slip velocity of fluid field near boundaries.

Korean Journal of Chemical Engineering,
Vol.34, No.5, 1366-1376, 2017

Novel multi-scale diffusion model for catalytic methane combustion

Huang K, Wang L, Xu Y, Wu D

Abstract - A multi-scale model of methane catalytic combustion was built by a series of balance equations and diffusion equations, and these equations were solved through the computational fluid dynamics (CFD) software. The difference between this work and previous model is the diffusion process in catalyst coating was considered. By analyzing the methane conversion, temperature distribution and mass fraction contours of every component, the performance of multi-scale model was compared with that of the pure CFD model without diffusion. The effects of diffusion, methane concentration, flow rate on the methane conversion and temperature distribution of monolithic reactor were also evaluated and discussed by the multi-scale model. The multi-scale model showed better accuracy than the pure CFD model without diffusion process. Different methane concentrations and gas flow rates had enormous effects on the methane conversion and temperature. Therefore, it was beneficial to the reaction process to adjust the methane concentration and gas flow rate appropriately.

Korean Journal of Chemical Engineering,
Vol.34, No.5, 1504-1508, 2017

Highly stable inverted organic photovoltaic cells with a V_2O_5 hole transport layer

Zafar M, Yun JY, Kim DH

Abstract - The stability of the hole transport layer (HTL) in inverted organic photovoltaic cells is of great interest because the conventional HTL material, PEDOT:PSS, shows limited stability. In this work, solution processed vanadium pentoxide (V_2O_5) was adopted as the HTL, and the effect of annealing on the properties of the HTL was investigated. The inverted organic photovoltaic cell fabricated with V_2O_5 and annealed for 5min at 165 °C showed the highest power conversion efficiency (PCE) of 3.92%, which is an enhancement of 16% relative to the cell with PEDOT: PSS (PCE=3.36%). The cell with V_2O_5 was also found to be more stable than the PEDOT: PSS cell, in which a 51% decrease in PCE was observed after 96 h. In contrast, over the same interval, the V_2O_5 device maintained a PCE 85% of the original value.

Korean Journal of Chemical Engineering,
Vol.34, No.6, 1591-1599, 2017

Recent advancements in bioreactions of cellular and cell-free systems: A study of bacterial cellulose as a model

Muhammad WU, Mazhar UI, Shaukat K, Nasrullah S, Park JK

Abstract - Conventional approaches of regulating natural biochemical and biological processes are greatly hampered by the complexity of natural systems. Therefore, current biotechnological research is focused on improving biological systems and processes using advanced technologies such as genetic and metabolic engineering. These technologies, which employ principles of synthetic and systems biology, are greatly motivated by the diversity of living organisms to improve biological processes and allow the manipulation and reprogramming of target bioreactions and cellular systems. This review describes recent developments in cell biology, as well as genetic and metabolic engineering, and their role in enhancing biological processes. In particular, we illustrate recent advancements in genetic and metabolic engineering with respect to the production of bacterial cellulose (BC) using the model systems Gluconacetobacter xylinum and Gluconacetobacter hansenii. Besides, the cell-free enzyme system, representing the latest engineering strategies, has been comprehensively described. The content covered in the current review will lead readers to get an insight into developing novel metabolic pathways and engineering novel strains for enhanced production of BC and other bioproducts formation.

Korean Chemical Engineering Research,
Vol.55, No.2, 156-162, 2017

Al-Ce 산화물에 담지된 CuO 촉매상에서 저온 CO산화반응
Low Temperature CO Oxidation over CuO Catalyst Supported on Al-Ce Oxide Support

박정현, 윤현기, 신채호

Abstract - CuO의 함량이 반응활성에 미치는 영향을 조사하기 위하여 CuO(x)/0.3Al-0.7Ce (x = 2~20 wt%) 촉매를 함침법으로 제조하고 저온 CO 산화반응을 수행하였다. CuO(10)/0.3Al-0.7Ce 촉매가 반응물 중 수분의 존재 유무에 관계없이 가장 우수한 반응활성을 나타내었다. 수분의 존재는 활성점에 CO와의 경쟁흡착으로 활성점이 감소하여 50% CO 전환율 온도인 T50%가 약 50 ℃ 고온으로 이동되어 관찰되었다. N2O-적정실험으로 구한 구리 표면적과 CO-펄스 실험으로 계산된 격자산소의 양은 CuO의 함량 증가에 따라 증가하였고, CuO(10)/0.3Al-0.7Ce 촉매에서 최대화되었다. 이러한 특성 분석결과는 사용된 촉매의 CO 산화반응에 대한 T50%의 경향과 잘 일치하였다. 위의 특성분석 결과로부터, CuO(x)/0.3Al-0.7Ce 촉매의 CO 산화반응에 대한 반응성은 구리 표면적과 격자산소의 양과 밀접하게 관련된다고 결론지을 수 있다.

Korean Chemical Engineering Research,
Vol.55, No.2, 214-219, 2017

SNIPS 공정을 이용한 블록공중합체 분리막의 구조 형성에 관한 연구
Fabrication of Block Copolymer Membranes via SNIPS Process

우상훈, 김진희, 이정현, 방준하

Abstract - 본 연구에서는 블록공중합체의 자기조립(Self-assembly) 성질과 상전이를 통한 비대칭의 다공성 구조를 형성하는 NIPS 기술을 결합한 SNIPS (Self-assembly and non-solvent induced phase separation) 공정을 이용하여 PS-b-P4VP 블록공중합체 분리막을 제조하였다. 기존의 연구는 단순히 원하는 구조 구현에만 집중되었고 SNIPS 공정상의 내재 변수(농도, 증발시간, 용매의 조성, 습도)들에 대한 체계적인 연구는 보고되지 않았다. 본 연구에서는 PS-b-P4VP와 DMF, 1,4-Dioxane, THF, DI를 이용해 내재 변수의 영향을 정성적으로 분석하였다. 그 결과, 용액의 농도와 휘발성 용매의 비율이 적당하고 습도가 낮은 환경에서 모폴로지가 최적화 되었으며, PS-b-P4VP 분리막은 표면에 잘 구현된 실린더 구조가 형성되었고 75%의 높은 기공도와 약 18%의 표면 기공도를 가지는 것을 확인하였다.

Korean Chemical Engineering Research,
Vol.55, No.2, 247-252, 2017

아미노실란과 콜로이드 실리카를 이용한 친수성 코팅 도막의 제조
Preparation of Hydrophilic Coating Films by using of Aminosilane and Colloidal Silica

안치용, 이병화, 송기창

Abstract - 실란커플링제인 아미노실란을 15~20 nm의 직경을 갖는 콜로이드 실리카와 반응시킴에 의해 친수성 코팅 용액을 제조하였다. 또한 친수성 코팅 용액을 폴리카보네이트 기재 위에 담금 코팅 시킨 후 120 ℃에서 열경화 시킴에 의해 친수성 코팅 도막이 제조되었다. 이 과정 중 아미노실란의 종류 변화가 코팅 도막의 물성에 미치는 영향을 연구하였다. 그 결과 아미노실란으로서 3-aminopropyltriethoxysilane (APTES)을 사용하여 제조된 코팅 도막은 25~44°의 접촉각과 B의 좋지 못한 연필경도를 나타내었다. 반면에 아미노실란으로서 3-aminopropyltrimethoxysilane (APTMS)을 사용하여 제조된 코팅 도막은 26~37°의 접촉각과 2H의 우수한 연필경도를 나타내었다.