

Poster Presentations

PSS16 : 극한환경 반응형 필터

PSS16-1 | A novel microreactor using stainless steel wire-mesh support catalysts for dry reforming of methane

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Catalytic dry reforming of methane (DRM) is a very handy route for the utilization of two greenhouse gases i.e., CH₄ and CO₂ for the production of synthesis gas (H₂/CO). DRM is an endothermic reaction and usually operates at high temperatures. Conventional fixed-bed reactors are most commonly used for DRM reaction but have some major issues such as large pressure drop and limited mass transfer capabilities. In order to overcome these issues of conventional fixed-bed reactors, microreactors with improved thermal stability, lower pressure drop and heat and mass transfer capability are good choice for catalytic DRM reaction [1]. However, one issue with microreactor is that blistering of the catalysts occur during reaction as the microstructured supports and the oxide catalysts exhibit different thermal expansion coefficients. Therefore, the formation of a uniform and well-adherent catalytic coating layer onto the microstructured supports is very important and need pretreatment in order to enhance the adhesion of oxide catalyst carriers. For this purpose, FeAl powder (\approx 60 μ m) was used on to stainless steel wire-mesh support surfaces to make them rough with irregular patterns to effectively coat catalyst carrier alumina slurry. Active roughening method of adding FeAl particles on to stainless steel wire-mesh support surfaces resulted in strong adhesion with γ -Al₂O₃ slurry [2]. After pre-treatment and washcoating with Ni-based hydrotalcite catalysts, microreactor was fabricated from stacking of stainless steel wire-mesh support catalysts in two configurations allowing parallel flow and cross-sectional flow and tested for dry reforming of methane using Ni-based hydrotalcite catalysts at 800 °C and 850 °C. Microreactor showed an excellent catalytic performance as conversion rates of CH₄ and CO₂ were obtained as 92 % and 95 % respectively, and syngas ratio 0.92. Stacking of stainless steel wire-mesh support catalysts for parallel and cross-sectional flow configurations caused the better mixing of reactant gases due to the tortuosity of the narrow porous microstructure of the support as well as enhanced heat and mass transfer and as a result, superb catalytic performance and

stability of microreactor was obtained. The excellent throughput was verified by numerical calculations using CFD simulations.

PSS16-2 | Superfast mineralization of isopropyl alcohol under UV light using iron oxide photocatalyst and persulfate

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The design of a superfast and environmentally-benign mineralization process for isopropyl alcohol (IPA)-contaminated water in the semiconducting manufacturing industry remains a great challenge. In this study, mesoporous Cu(x)-Fe₂O₃ catalysts with varying Cu doping levels were prepared via a facile thermal treatment method and their characterization results confirmed the homogeneous distribution of Cu on the Fe₂O₃ surface. The complete degradation and full mineralization of IPA (10 ppm) were achieved by UV/peroxydisulfate(PDS)/Cu(0.5)-Fe₂O₃ system within 1 and 30 min, respectively, being superior to the system without catalysts and UV/PDS/pristine Fe₂O₃ system. The electron paramagnetic resonance and the quenching tests demonstrated that PDS was synergistically activated by UV irradiation and photo-generated electron from the conduction band of Cu-Fe₂O₃ photocatalysts yielding more SO₄^{•-} and [•]OH radicals. Electrochemical studies revealed that Cu doping facilitated the interfacial charge transfer and decreased the recombination of electron-hole pairs. Moreover, the catalytic performance of the freestanding immobilized Cu(0.5)-Fe₂O₃ film was comparable to that of the powder-type system. The facile synthesis of highly-active catalysts towards the superfast IPA mineralization by PDS-based AOPs shows promising prospects for environmental applications in semiconductor industries where both processing time and cost are crucial.