ChE Graduate Seminar Series

Departmental Seminars Presented by Ph.D. Students

Catalytic Conversion of methane to higher hydrocarbon

Sachchit K Majhi (Advisor: Prof. K. K. Pant)

14th February 2013, Thursday, 0400-0425 pm (15+10 mins), ChE Seminar hall

With the declining of crude oil reserves, the energy supply is changing from being primarily oil based to become more gas based. Methane is the major component of most natural gas reserves; hence, it is important to investigate the conversion of methane for potential utilization. On the other hand, methane is the most stable and symmetric organic molecule consisting of four C–H bonds with bond energy of 435 kJ/mol, became a challenge for conversion on the aspect of catalysis science. The catalytic conversion of methane can be divided into two groups, which are described as indirect and direct. The indirect processes rely upon the production of synthesis gas, either by reforming reaction or by partial oxidation, followed by Fischer–Tropsch chemistry. On the other hand, methane can be converted directly to the desired products, e.g. olefins and aromatics. The direct conversion of methane into products with higher added value can eliminate the intermediate costlier step of production of synthesis gas. The HZSM-5-supported Mo catalyst seems to be the most appropriate catalyst for direct methane conversion to higher hydrocarbons. Addition of a metal promoter enhances the catalytic activity and selectivity to benzene and other hydrocarbons. The catalysts namely 5%Mo/HZSM-5, 2%Zn-5%Mo/HZSM-5 and 2%Ga-5%Mo/HZSM-5 were prepared by wet impregnation method. The performance of the prepared catalysts was tested in fixed bed quartz reactor at atmospheric pressure using 1gm of catalyst and at different temperatures. The calcined catalysts were first reduced in situ under the hydrogen nitrogen mixture for four hours. After reduction methane was introduced in to the reactor. Catalysts were characterized in terms of BET surface area, pore volume, TPR, XRD, SEM-EDX. The surface area of the catalyst was found to be 255.5 and 242.2 m^2/g respectively. Two peaks were observed during the TPR study, one for the molybdenum species which reduced at 450 ^oC other peak was found after 750 C which may be due to the metal support interaction. The phase presents in all the catalysts were in oxide form revealed from the XRD result. The uneven surface morphology having particle size ranges between 20-100 nm were found from SET-EDX study. Experimental results revealed that the maximum conversion value of 21% was achieved for 2%Zn-5%Mo/HZSM-5 at 800 ^oC catalyst with aromatic selectivity approximately 80%. The catalyst had a reasonably good stability for conversion of methane at 800 ^oC .

The motility of bacteria in anisotropic liquid environment

Anil Kumar (Advisor: Prof. S. K. Pattanayek)

14th February 2013, Thursday, 0425-0450 pm (15+10 mins), ChE Seminar hall

The study of the behaviour of microorganisms such as bacteria in realistic environments is key to understanding how they colonise living organisms. While the influence on bacterial motility of many genetic and biochemical factors have been extensively studied, there have been limited studies of the impact of physical parameters. Thus, despite the fact that natural environments are often asymmetric, the majority of behavioural experiments with bacteria have been done in isotropic water solutions. In this talk, we wish to show the effect of anisotropic environment on movement of E. coli bacteria. We have used DSCG liquid crystal as host to understand the behaviour of the microorganism. We found that the behaviour of the microorganism is drastically different in media that are not symmetric as for example, the trajectories and orientation of bacteria abruptly change with the orientational phase transition of the host DSCG.

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Direct Hydrocarbon Solid Oxide Fuel Cell

Gurpreet Kaur (Advisor: Prof. S. Basu)

14th February 2013, Thursday, 0450-0515 pm (15+10 mins), ChE Seminar hall

Solid oxide fuel cells (SOFC) offer a promising pathway for environment friendly electrical generation. Owing to high operating temperature they exhibit high fuel flexibility. The principle relies on direct conversion of the hydrocarbon into electricity by electrochemical oxidation reactions and eliminates the need of reforming of hydrocarbons. In this talk, the performance of Cu-Fe/CeO_2/YSZ based anodes for SOFC application using n-C_4H_{10} fuel will be discussed. The electro-catalysts based on Cu-Fe bimetallic anode for use of both H_2 and n-C_4H_{10} fuels in SOFC are prepared by wet impregnation method into a porous CeO_2-YSZ matrix. The prepared Cu-Fe/CeO_2-YSZ anodes are then characterized by thermo-gravimetric analysis (TGA), X-ray diffraction (XRD), elemental dispersive X-ray (EDX) and scanning electron microscopy (SEM). Carbonaceous deposits formed on Cu-Fe/CeO_2-YSZ anodes after exposure to n-C_4H_{10} are studied using a combination of i–V characteristics and electrochemical impedance spectroscopy. It is observed that the addition of Fe to Cu in CeO_2-YSZ cermet anode enhance the performance in H_2 and n-C_4H_{10} fuels. The performance of cell having molar ratio of Cu-Fe of 1:0 and 1:1 in Cu-Fe/CeO_2-YSZ anode shows power density of 100 and 240 mW cm^{-2} in n-C_4H_{10} and 120 and 260 mW cm^{-2} in H_2 after n-C_4H_{10} flow at 800 ºC. The long term performance test has been conducted on Cu-Fe/CeO_2-YSZ anode having molar ratio of Cu:Fe of 1:1 in H_2 and n-C_4H_{10} fuel at 800 °C. A slight increase followed by decrease in performance was observed with time in n-C_4H_{10} fuel at 800 ºC and it is mainly due to carbon formation as corroborated with electrochemical impedance spectroscopy.

0515 pm High Tea