Abstract No: TP 26

Utilization of synthetic silica and cross-linked polymethyl methacrylate (PMMA) as anti-block agents and evaluating their influence on desirable physical properties of power cables

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A cable is composed of three major components, namely, conductor, insulation, and jacket. Copper and aluminium are widely employed as conductors in cables. PVC is a popular insulating material, which offers outstanding resistance to a wide range of corrosive fluids, flame, moisture, and abrasion. The adhesion between the insulation and jacket (blocking) is one of the major problems associated with the production process of power cables. To overcome this problem, a talc bath is used in the conventional cable production process. However, the conventional method is not an efficient way to prevent blocking. Surface modification using anti-blocking agents can be employed as an effective way of preventing blocking. Anti-blocking agents function by creating microscopic imperfections on the surface of the polymer layer. In this study, a surface modification was done for both the insulation and jacket using synthetic silica and cross-linked PMMA. However, the addition of the above anti-blocking additives should not negatively affect the other desired physical properties of cables. Effects of these two anti-blocking agents on other physical properties, such as heat stability, tensile strength, elongation at break, insulation resistance, and pressure stability at high temperatures, were evaluated. A system of synthetic silica and cross-linked PMMA provided better separation of layers and good quality of surface as anticipated, due to their synergistic effect. Also, the insulation resistance had significantly improved upon the addition of these two anti-blocking agents. However, higher levels of PMMA might soften the final polymer, and hence, it reduces the tensile strength of the insulation and jacket.

Keywords: Blocking, Cable, Anti-blocking, polymethyl methacrylate (PMMA), synthetic silica

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Abstract No: TP 32

Modified copper-based metal-organic frameworks as novel photoanode material

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Metal Organic Frameworks (MOFs) are highly porous, crystalline, and well-ordered organic-inorganic hybrid channel structures. Their physical and electronic properties, such as surface areas, band gaps, and photoactivities, can be fine-tuned simply by changing the organic linker ligand or the metal center or by incorporating molecules into channels of MOFs or by post-synthetic modification methods. Linkers of some MOFs can act as light-harvesting antennae and most of them absorb light from the visible region. Hence, those kinds of MOFs are suitable as sensitizer materials of the Dye-sensitized Solar Cells (DSCs) and their light absorption capacity can further be improved by post-synthetic modifications. In this project, a novel composite of MOF-199 and TiO_2 nanoparticles (MOF-199 coated TiO_2) were designed and synthesized. This novel material was characterized by using PXRD, FT-IR, SEM, and Mott-Schottky analysis and it was used as a new photoanodic material of DSCs. EIS investigation showed that the MOF-199 coated TiO_2 structure is essential to reduce the charge-transfer resistance of the TiO_2/ MOF/ electrolyte interface. The MOF-based solar cell devices were fabricated by using the screen-printing method and optimization was done through layer thickness, the ratio of MOF:TiO_2, and the type of electrolyte. These novel photoanode-based SCs exhibited 0.004% efficiency (η) and the conductivity and light absorption capacity were improved by adsorption of Rhodamine G6 to that structure. It leads to significant improvement in cell efficiency (η = 0.022%) with Voc = 0. 44 V, Jsc = 0.1 mA cm^{-2} , and FF = 0.42.

Keywords: Metal-organic frameworks, Sensitizer, Post-synthetic modification, TiO_2

Abstract No: TP 36

Pyrolysis of waste polypropylene to fuel oil

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Plastic waste accumulation in the environment has increased rapidly. This is mainly due to their versatile properties, which allow them to be used as substitutes for wood, metals, ceramics, and glass. They have diverse applications, as they are light-weight, durable, cost-effective, and stable products. However, the world is experiencing the adverse effects of plastic debris in the environment due to plastic waste mismanagement. Pyrolysis of plastic has been identified as an effective method of plastic waste management by converting the waste into fuel oil, char, and gases. The pyrolysis of waste polypropylene (PP) using a low-cost, simple lab-scale apparatus in the presence and absence of catalysts is discussed here. In the current research, the efficiency of the catalyst, Zeolite Socony Mobil-5 (ZSM-5), in pyrolysis process was investigated. The generated volatile products were condensed into resultant liquid oil. Active carbon filters and organic solvents were used to trap the non-condensed gas fraction to prevent possible atmospheric pollution. The non-catalyzed pyrolysis of PP resulted a high liquid yield of 79.57 ± 1.66 wt. % with a low gaseous yield (14.64 ± 0.84 wt. %) at 330 °C while the ZSM-5 catalyzed process reduced the liquid yield to 56.88 ± 2.29 wt. % and increased the gaseous yield (38.13 ± 1.88 wt. %) at 280 °C. Then resultant liquids were fractionated based on the boiling points of several petroleum fractions (naphtha, kerosene, and diesel) and each fraction was analyzed by GC-MS to identify the constituent compounds. Accordingly, the non-catalyzed pyrolysis produced 3,3,5-trimethyl-heptane ($C_{10}H_{22}$), 4-methyl-2-undecene ($C_{12}H_{24}$), 1-dodecene ($C_{12}H_{24}$), and 2-methyl-1-hexadecanol ($C_{17}H_{36}O$) while the catalyzed pyrolysis with the ZSM-5 resulted 1-ethyl-2-methyl-benzene (C_9H_{12}), 3,3,5-trimethyl-heptane ($C_{10}H_{22}$), (Cyclopentylmethyl)-cyclohexane ($C_{12}H_{22}$), and n-Nonylcyclohexane ($C_{15}H_{30}$) as the major constituents.

Keywords: Pyrolysis, polypropylene waste, catalyst, GC-MS, fuel oil

Acknowledgment: The World Bank AHEAD DOR Grant.