5th International Symposium on
Applied Engineering and Sciences (SAES2017)
14th–15th November 2017 | MALAYSIA
UNIVERSITI PUTRA MALAYSIA, SERDANG, SELANGOR

Presentation code:

M12

PAN/Lignin/TEOS Nanofibers as Precursor for the Production of Carbon Nanofibers

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Abstract. Carbon nanofibers (CNF) is widely applied as heat-management materials, composite reinforcement, filtration membrance, and energy storage. Polyacrylonitrile (PAN) is the main precursor for fabrication of CNF due to its brilliant properties such as high specific surface area, high aspect ratio, high mechanical strength and flexibility. However, the manufacturing prices is high. Low-cost carbon nanofibers can be fabricated from renewable materials such as lignin. It is a second most abundant raw material on earth and can be obtained easily. Tetraethyl orthosilicate (TEOS) can be added into the CNF as pore generator to generate more porous surface and catalyze the stabilization process. Porous surface is very important in providing the CNF with high electrical performance such as improved electric double-layer capacitance in supercapacitor. In this study, lignin/PAN/TEOS carbon nanofibers was lignin/PAN/TEOS carbon nanofibers were prepared by using electrospinning method followed by the heat treatment of the up to 1000°C. Electrospun nanofibers were characterized by TGA, DSC and SEM while the carbon nanofibers were characterized by using FTIR and FESEM. The TGA results show that the major degradation temperature decreased to around 270-280°C after lignin is added due to the lower thermal stability of lignin. DSC results show the addition of TEOS shifted the exothermic peaks to lower temperature due to catalytic ability of TEOS. This indicated that the stabilization process of TEOS-incorporated CNF is kinetically higher than those without TEOS. SEM images show the morphology and diameter of the sample which decreased as the lignin concentration was increased. IR spectra show peaks around 1100 cm-1 which is correspond to Si-O-C bond. This indicated the successful formation of Si-O-C/Si-O-Si structures which will influence the properties of CNF such as electrochemical performances. FESEM shows the fiber diameter decreased as TEOS amount increased and pores were successfully produced at the surface of carbon nanofibers.

Keywords: Lignin, carbon nanofibers, porous, electrospinning, polyacrylonitrile