Abstract

Investigating Pyrolysis Conditions of Coals for Carbon Fiber Production

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In light of recent trends in decreased use of coal for energy generation, many investigators are searching for ways to create alternative, high-value products from this plentiful resource, such as carbon fiber. Our initial work has shown that the pathway to carbon fiber production is more straight forward using a commercially-provided, refined coal tar pitch (CTP) derived from coking coals, as compared to using non-coking, lower rank coals. In this work, we are interested in demonstrating the ability to create quality carbon fiber from traditionally non-coking coals, and we will present our efforts to link the two processes of pyrolyzing raw coal with coal tar upgrading to produce mesophase CTP.

Herein we compare pyrolysis and coal tar upgrading on different coals (Illinois #6, Utah Sufco, and a PRB coal). The coal pyrolysis was performed in a two-stage reactor, where the tars from primary pyrolysis were further heated to induce secondary gas phase reactions. We looked at the effect of gas phase secondary reaction residence time on the coal tar composition and characteristics, and used several analytical techniques to infer what properties are needed to create mesophase CTP. These techniques included matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF-MS), thermogravimetric analysis (TGA), Fourier-transform infrared spectroscopy (FT-IR), and nuclear magnetic resonance spectroscopy (NMR). The coal tar was then upgraded to mesophase CTP in a small lab-scale reactor, where the mesophase content was determined by polarized microscopy. The samples created were compared against a commercial CTP, which has been shown by our co-investigators at the University of Kentucky to be an effective feedstock for spinning carbon fibers.