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Coal to Carbon Fiber

Demand for carbon fiber continues to grow at approximately 10% compound annual growth rate (CAGR). Over 90% of it is derived from polyacrylonitrile (PAN) precursor fiber, as it offers a high toughness carbon fiber for structural applications. Yet pitch-precursor-derived carbon fiber offers some key advantages over incumbent PAN-based carbon fiber. First, pitch can be melt spun, whereas PAN is solution spun. Melt spinning is significantly more economical and quite a bit faster than solution spinning; solution spinning is particularly expensive in terms of solvent use and recovery. Second, pitch typically has superior carbon yield, up to 80 wt.% conversion, while PAN offers approximately 50% conversion. There is future interest in the utilization of pitch for low-cost carbon fiber. Precursor pitches can be derived from petroleum and/or coal feedstocks. Coal tar is primarily generated from the overheads of coking processing of metallurgical coal. Upgrading coal tar to a pitch offers a viable path to high aromaticity pitches – from which liquid crystal, or mesophase, pitch can be derived. Mesophase-pitch-based carbon fibers offer extremely high stiffness and thermal conductivity.

Here we report our work utilizing coal tar pitch as a precursor for carbon fiber. We will discuss the coal tar extraction, and pitch upgrading processes. Quantifiable aspects of the pitch which are desired for high spinnability will be discussed. The melt spinning process will be presented, followed by oxidation and carbonization processing. The resultant carbon fiber properties and yields will be discussed in the context of existing carbon fibers