

Polyacrylonitrile spectroscopy, stability and phase transitions

Polyacrylonitrile (PAN) fibers are an industrially important raw material for carbon fiber manufacturing. Typically, acrylonitrile monomers are polymerized with acidic co-monomers to improve fiber spinning and processes for carbonization. Stabilization is the first of a series of high temperature treatments, which are affected by these acid comonomers. Our goal in the Ford Team at NC State is to minimize the thermal energy required to stabilize PAN precursors for carbonization. To evaluate the effect of biobased additives on PAN fiber stabilization we must employ thermal analytical techniques such as differential scanning calorimetry (DSC). DSC can provide information about the energetics of PAN stabilization; however PAN can simultaneously occur with degradation. The research goal of the proposed study is to employ modulated DSC to determine whether its reversing and nonreversing modes can separate thermal transitions due to melting, degradation and solvent removal. Once the degradation peak is identified, compare and contrast the thermal energies for stabilization. Also, employ spectroscopy to determine whether the ladder structure (or cyclization) has occurred.

Reference: M. Lewin, "Handbook of Fiber Chemistry" 2007 (electronic version available via NC State library, see section on Acrylics melting and stabilization for carbon fiber manufacturing)