The research of Dr. John R. Collier and his students involves rheology (i.e. flow behavior) and the processing of polymers. He has invented a hyperbolic convergent flow system that is used to characterize the elongational rheology at fabrication conditions. This system enables the evaluation of elongational viscosity as a function of temperature, elongational strain rate, and Hencky strain. It also provides an estimate of the body forces that must be overcome to impose orientation on polymer melts and concentrated solutions. The elongational flow behavior in convergent dies is being applied to induce orientation with potentially fewer defects than would occur in normal tensile force driven orientation development processes. Enhanced precursors for carbon fibers are being developed and use of high flux magnetic fields will be employed to retain orientation developed in convergent flow dies and to develop orientation. The focus of polymer processing operations is on orientation inducing processes such as: dry/wet solution spinning and melt spinning of fibers, and on melt blowing of non-wovens.

Part of Dr. Collier’s research is focused on conversion of biomass to fabricated products and conversion to energy sources. Cellulose from wood and from agricultural residues is converted to enhanced fibers through solution in ionic liquid and lyocell solvents and then regenerated as fibers by contact with water. Both ionic liquid and lyocell solvents are regarded as green or environmentally favorable solvents since neither has a significant vapor pressure, hence no atmospheric pollution. Furthermore, the lack of a vapor pressure, yet thermal stability enables these solvents to be completely recovered and recycled by evaporation of water from the diluted solvent. Biomass accumulated at industrial sources is also a candidate for conversion to hydrogen and other energy sources. Bagasse from sugar cane processing, draff from whiskey production, and residues from food processing are all candidates that overcome the common problem of transporting dispersed sources of low density bulk material to conversion facilities.

Another biomass research area in Dr. Collier’s interest is the production of whisk(e)y from grains and the interaction of the maturing spirits with the oak casks. The character of whisk(e)y is affected by the grain source, the processing conditions used to extract, ferment and distill the spirits, and the maturation conditions during aging. Research projects in this area are current and evolve from the hands on whisky making classes he conducts in cooperation with the Bruichladdich Scotch whisky distillery on Islay in Scotland and interaction with American whiskey companies.

Dr. Collier’s webpage.