The nanoscale engineering that is used to optimize the performance properties of products made from semicrystalline polymers usually uses strong shear fields that lead to highly anisotropic microstructures resulting from polymer crystallization. These microstructures are typically mixed with others consisting of voids and/or ordered amorphous regions. Sorting out the components of such complex microstructures has traditionally been a very difficult task.

This presentation illustrates the manner in which experimental protocols involving stepwise rotation of oriented polymer samples coupled with area detector data collection as a function of sample temperature can provide greatly improved descriptions of polymer microstructure. Because of the large number of patterns required these protocols are best carried out on high throughput cameras at synchrotron sources. Considerable success has also been achieved with laboratory x-ray sources and neutron scattering facilities. The method, which is based upon the difference in thermal expansion coefficient between crystalline and amorphous domains in semicrystalline polymers, has been discussed elsewhere[1].

This presentation describes the application of the method to microstructure characterization in a variety of products extruded from polyethylene, nylon 66, poly(4-methyl-1-pentene), and syndiotactic polystyrene. Wide-angle XRD results obtained as a function of rotation angle at room temperature are correlated with the SAXS results in order to better define the relationship between the lamellar morphology and the crystalline unit cell in these materials. Portions of this work were carried out at NIST before Dr. Barnes’ retirement from there.