eXPRESS Polymer Letters Vol.1, No.8 (2007) 481
Available online at www.expresspolymlett.com
DOI: 10.3144/expresspolymlett.2007.67

Editorial corner – a personal view
Molecular functionality and self-assembled polymer compositions

*R. A. Shanks**

School of Applied Sciences, RMIT University, GPO Box 2476V, Melbourne, 3001, Australia

Most organic molecules exhibit shapes with low inter-conversion energy, called conformations. As polymer molecules are larger, conformation becomes much more significant than molecular structure because larger molecules have many possible conformations in addition to an increase in the associated inter-conversion energy. Conformational control enables self-assembly into supramolecular structures. Common supramolecular structures are crystals, polymer dispersed fillers, solvated additives, interactions between blended polymers and surface adsorptions.

Polymer science has advanced to where each of the components of a composition can be designed to migrate to the specific locations so that controlled properties can be introduced. Polymer scientists are able to design polymer conformation through symmetry, specific interactions, and molecular orientation. While this can be used in nano-composites and molecular imprinted patterns, it is beneficial in all polymer compositions.

Migration of fillers and additives to the required positions are useful tools to assemble the required structure. In addition to uniformly dispersed fillers, more can be done with fillers that link to form agglomerates or that are preformed into aggregates such as chains or branched clusters that impart new properties such as electrical conductivity, rheological and mechanical innovations. While shear and orientation from processing are useful, it is the molecular interactions and symmetry that provide the thermodynamic impetus for self-assembly and subsequent supramolecular chemistry. Shear cannot impart what thermodynamics does not allow, though shear can accelerate the kinetics.

When the interactions and symmetry are designed into a system, then supramolecular structure can automatically form. This is demonstrated by proteins where the primary structure of the amino acid chain controlled the secondary conformation, tertiary folding and the quaternary clustering of protein sub-units into the biologically active form. Adapting this analogy synthetic polymers can be designed with components that spontaneously form supramolecular constructions. The need for nano-components is less important than the need for the system to possess suitable interactive chemistry.

Polymer science has emerged as the field where elaborate structures are designed with macromolecules, resembling the approach to building and machine design in the macroscopic world. When the components of polymer compositions contain complementary chemical and symmetrical form they can self-assemble into supramolecular structures with specific properties.

Prof. Dr. Robert A. Shanks
Member of International Advisory Board

*Corresponding author, e-mail: robert.shanks@rmit.edu.au