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Spectroscopic Analyses of Microstructures Associated with Plant Based Polymers

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Currently, less than 0.02% of polymers used are plant based with the rest originating from petroleum feedstock. There are a number of applications that require some of these new polymers, independent of the cost of the petroleum. Because of their size scale, it is most appropriate to use vibrational and NMR spectroscopy to characterize the microstructure of these plant based polymers. We present a number of examples in order to illustrate the use of these alternative polymers. Soybean is one of the most promising alternatives. Both its saturated and unsaturated components can be utilized. In various applications, the saturated component is important because the rapid crystallization directly controls the rheological behaviors. This is especially significant if cocrystallization with other polymers, especially statistically random copolymers, is an important consideration. Crystallization kinetics and subsequent morphological units formed have yet to be characterized. In addition, the unsaturated component can be modified to form various polyols for use in reactive mixtures. The miscibility behavior of such polymers with other oligomers or polymers strongly influences the reaction kinetics and the products formed. The extreme hydrophobic nature of soybean based polymers is reflected in that it has opposite physical properties to that of the hydrophilic polyols used in the current formulations. We also have significant interest in poly(lactic acid). We have characterized the inherent structural rigidity, correlating the changes in chain conformation to the chain conformation. We have identified the intermolecular forces which stabilized the crystalline units. In addition, we have been able to control the crystallization process resulting from addition configurational defects. These applications illustrate the opportunities we have available in a world which may embrace such a set of polymers.