590e Determining Branch Content in Polymers: a Novel Technique Combining Small Angle Scattering and Fractal Geometry

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The properties of commercial polymers are highly influenced by the presence of branch units along the backbone. Structural branch units control not only end-use physical properties, but also have a huge role to play in the processability of polymer melts due to their influence on polymer chain dynamics. The degree of crystallinity of semi-crystalline polymers, which determines the final properties of such materials, is directly linked to the presence/absence of branch units along the main chain. Though many decades of effort have been made, our ability to describe long-chain branching analytically is at an early stage. Existing techniques in polymers based on gel permeation chromatography (SEC) and rheology to quantify branching are, at best, qualitative; and a quantitative characterization technique like nuclear magnetic resonance spectroscopy (NMR), has limitations in providing routine quantification. The inability of NMR to quantify long-chain branching has been the crux of the problem. We present a novel technique based on small angle scattering to quantify long chain branch content in terms of the volume fraction of material in the branches. Obtaining such information from scattering data involves considering the fractal nature of a branched polymer system. It is proposed that complimenting scattering data with NMR studies could provide in-depth quantification of branch content in a branched system.