Title: Nonlinear 2-dimensional Rheology for Long Chain Branching Semi-quantification in Polyethylene

Main Author:

Name: Yingxin Liu
Organization: SABIC
Country: The Netherlands

Co-Authors:

Co-author 1: Jacques Tacx
Organization: SABIC
Country: The Netherlands
Co-author 2:
Organization:
Country:
Co-author 3:
Organization:
Country:
Co-author 4:
Organization:
Country:
Co-author 5:
Organization:
Country:
Co-author 6:
Organization:
Country:

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Reference 6:
Reference 7:
Reference 8:
Reference 9:
Reference 10:
Reference 11:

Images:

Images Guidelines: *Please provide maximum one, on a separate file (doc, pdf, tiff, gif, or bmap), and at a reasonable resolution.*

Abstract:

The detection and quantification of branching architectures have been a major issue for polyethylene (PE) industry, which diversifies the final product properties, e.g., density, crystallinity and the processing technologies.[1,2] It is well established that long chain branching (LCB) increases PE (zero shear) complex viscosity and shear-thinning under shear flow and gives strain hardening under elongation flow.[3] However, it is still challenging to rheologically determine LCB densities without combing other technologies (nuclear magnetic resonance or chromatography).[4, 5] In this study, we have successfully excluded the molar mass impact on strain hardening reflection of LCB in extension rheology, and further developed a novel two dimensional (2D) mapping tool by incorporating the Fourier analysis of large amplitude oscillatory shear rheology. PE samples with various molecular topologies from linear, sparsely, medium, densely LCB and even super branched ones, are remarkably differentiated in our 2D mapping, and well described by a mathematical equation (R squared=0.99).

$$SHC=236.8 \cdot n^{-9.3}$$

Where SHC and n refer to strain hardening coefficient and Fourier exponent dependence on the deformation strain, respectively.

This advanced 2D mapping methodology enables a semi-quantification of LCB densities based on a simple set of rheological experiments, excluding the classic disturbance of both molar mass and polydispersity.

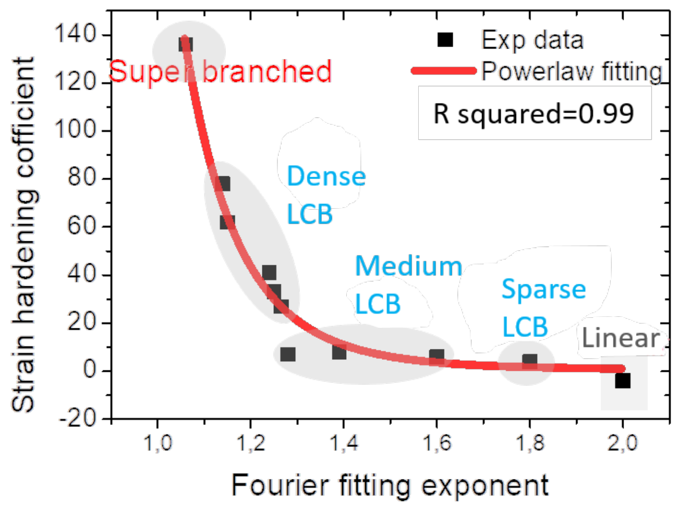

Figure 1. Two dimensional mapping of long chain branch density in PE by Fourier rheology and extension rheology.