



Martin-Luther-Universität Halle-Wittenberg
Naturwissenschaftliche Fakultät II
Chemie und Physik
SFB TRR 102



POLYMER- UND SOFT-MATTER-SEMINAR

iGK Lecture Series

Tuesday, **08.05.2012**, 5.15 pm - *1. Chain relaxation in HDPE*

Tuesday, **15.05.2012**, 5.15 pm - *2. Structure evolution at lamellar scale during tensile deformation in HDPE*

Tuesday, **22.05.2012**, 5.15 pm - *3. Mechanism of slow crack growth in HDPE: network vs tie molecules*

Tuesday, **29.05.2012**, 5.15 pm - *4. Structural basis of a transparent HDPE film*

Speaker:

Prof. Dr. Yongfeng Men

State Key Laboratory of Polymer Physics and Chemistry,
Changchun Institute of Applied Chemistry,
Chinese Academy of Sciences,
Renmin Street 5625,
130022 Changchun, P.R. China

This is a ring lecture, which is eligible for credit points for your iGK certificate.

Venue: VDP 1.27 Seminarraum Chemie, Von-Danckelmann-Platz 4,
06120 Halle



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Lecture Series

Prof. Dr. Yongfeng Men

Abstract:

High density polyethylene (HDPE) resins for various applications are produced commercially in large volume. They are used as pipes for long distance water, gas and oil distribution, containers, parts of furniture and so on. All these applications require certain mechanical properties ensuring their safe use. Obviously, macroscopic mechanical properties are consequence of the response of their microscopic structures upon external load. In these series of lectures, we aim to report several basic physical problems often faced in polyethylene industry.

- After giving a brief introduction of HDPE, especially bimodal HDPE for pipe applications, we discuss mechanical relaxation in HDPE. It can be shown that at least two crystalline alpha relaxations exist in HDPE originating from crystalline block slips and chain diffusion, respectively. To the end of chain diffusion, we performed small neutron scattering experiments showing that such diffusion is of segmental scale but not whole chain behavior (Lecture 1);

- Driven by the fact that failure of a bulk HDPE often involves large scale plastic deformation, we aim to clarify structural evolution details at lamellar scale level using synchrotron small angle X-ray scattering (SAXS) techniques. Mechanism of structural transition from spherulites to fibrils during deformation, as well as role of different components such as amorphous phase and tie chains linking adjacent lamellae will also be discussed based on selected semicrystalline samples where tie chain density can be tuned easily (Lecture 2);

- Using knowledge gained on the fundamental physical properties of HDPE, we show in this part how and why slow crack growth in HDPE is not related directly to the number of tie chains. Materials showing excellent slow crack growth resistant contains less tie chains but much mobile amorphous phase. Such systems also exhibit homogenous crystallization behavior despite wide distribution in molecular weight (Lecture 3);

- Last we show a special case met during industry development of new products using old materials, namely seeking reason of high optical transparency of a HDPE sample after an anisotropic biaxial stretching close but below its melting point. X-ray scattering results indicate that the transparent sample shows only density fluctuation along the lamellar normal at room temperature. Only at elevated temperatures, fibrillar (cylindrical) like structure is visible which disappears again upon cooling. Further modeling work revealed that the model including only 3 to 5 lamellae for each stack best fit the SAXS data meaning that even in the lamellar normal direction the size of the objects is far smaller than the wave length of visible light (Lecture 4).