INDUSTRIAL PILOT PROJECT

Characterization of thin extrusion-coated polymer films by combined in-situ tensile testing and X-ray scattering

THE INDUSTRIAL CHALLENGE

There is a need for Tetra Pak® to characterize polymer structures of thin polyethylene films in packages undergoing mechanical deformation. The polymer films in the packaging material are produced in the extrusion coating line by rapid cooling of molten polymer at high flow speeds. The polymer molecules quickly cool and are far from equilibrium. Consequently, it is difficult to predict the resulting structures formed. The polymer films studied are very thin, which means that obtaining sufficient scattering intensity using eg. laboratory based small angle X-ray scattering (SAXS) is challenging.

WHY USING A LARGE-SCALE FACILITY

Synchrotron SAXS measurements provide a vast improvement on the time resolution, which means that polymer morphology in the films can be studied in real time as they are also mechanically stretched. The aim was to understand the potential of using synchrotron SAXS with tensile testing.

HOW THE WORK WAS DONE

A team from Tetra Pak® and the Niels Bohr Institute (NBI) performed SAXS measurements at the Petra III (P03) synchrotron in Hamburg. The setup was planned together with Research Institutes of Sweden (RISE). Samples were studied in P03 beamline using an in-situ tensile stress testing (TST) apparatus, and measurements were performed with real-time resolution during stretching. Data with sufficiently high intensity resolution was successfully obtained and provided information about the stretching process in real-time as well as relaxation processes, with time resolution of 1 s. The P03 staff Dr. Matthias Schwartzkopf and Prof. Stephan Roth are gratefully acknowledged.

THE RESULTS AND EXPECTED IMPACT

The synchrotron SAXS measurements made it possible to correlate differences in the properties of the polymer films during deformation to differences in their corresponding structures. The collaboration of Tetra Pak®, NBI and RISE has increased the awareness and knowledge of the potential of techniques which will become available soon at MAX IV, situated close to Tetra Pak® in Lund. These characterization techniques are important for optimizing materials and process settings for optimal package functionality in any polymer material in an environmentally sustainable future.

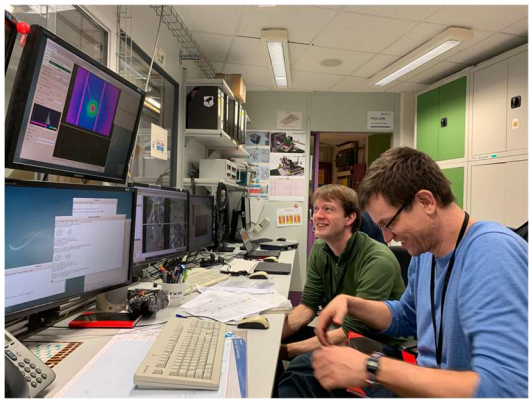

Figure. Dr. Erik Brok and Dr. Martin Schmiele from NBI evaluating the experimental data at the Petra III synchrotron.

"With the developed methodology we can characterize and compare morphology, structure and material orientation after manufacturing and during mechanical deformation of thin extrusion coated polymer films." /Anna Svensson, Tetra Pak

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