BLEND MORPHOLOGY, FILLER DISTRIBUTION AND MICROMECHANICAL MECHANISMS OF SBR/NR RUBBER BLENDS

Sven Henning[a], Matthias Menzel[a], Andreas Heilmann[a], Joachim Kiesekamp[b], Sybill Ilisch[b], Goerg H. Michler[c]

[a]Fraunhofer Institute for Mechanics of Materials IWM, Walter-Hülse-Str. 1, 06120 Halle, Germany, sven.henning@iwmh.fraunhofer.de
[b]Styron Deutschland GmbH, Bertastraße 13/ F1, 06258 Schkopau, Germany
[c]Department of Physics, Martin Luther University Halle-Wittenberg, Von-Danckelmann-Platz 3, 06099 Halle, Germany

ABSTRACT

The presentation summarizes the development and application of advanced preparation techniques for the imaging of the morphology and resulting micromechanical effects in rubber blends filled with different nanofillers. Aim of the work was the simultaneous imaging of the rubber blend phase morphology and the nanofiller distribution. Cryo-ultramicrotomy (RMC PowerTome PT-PC/CR-X) was applied to generate ultrathin sections for morphological and micromechanical analyses by means of TEM (LEO 912 EFTEM and Philips CM20). The resulting block faces were utilized to achieve optimum results in AFM imaging. JPK Nanowizard II and Nanowizard III AFM instruments were applied to analyze the phase morphology. It is shown that synthetic/natural as well as synthetic/synthetic rubber blend phases can be distinguished with excellent contrast (Fig. 1a). A special setup was used for tensile deformation of ultrathin sections *ex situ*, i.e., without electron beam exposition. Subsequently, deformation zones were imaged using TEM (Fig. 1b). It is shown that, depending on blend composition, phase morphology, and filler distribution, micromechanical effects can comprise nanovoid formation, fibrillation and/or interfacial delamination as the initial deformation mechanisms.

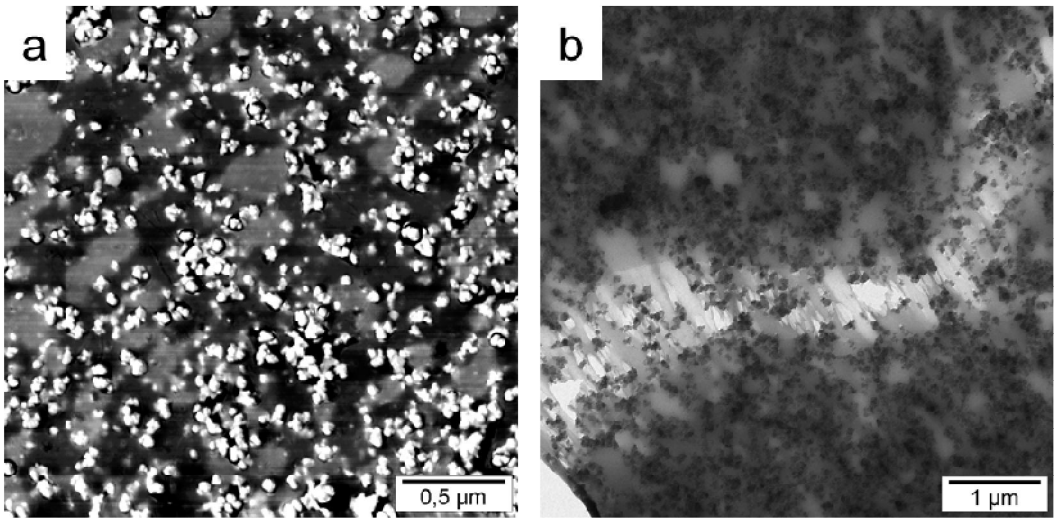

Fig. 1: a) Morphology of a SSBR/SSBR blend filled with carbon black; AFM phase image and b) micromechanical processes in a SSBR/NR blend filled with carbon black; tensile deformation of an ultrathin section, EFTEM image

Acknowledgement: The support of the Ministerium für Wirtschaft des Landes Sachsen-Anhalt (project numbers 1004/00024 and 1304/00022) is gratefully acknowledged.