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Citation for published version (APA):

Jansen, B. J. P., Rastogi, S., Meijer, H. E. H., & Lemstra, P. J. (1996). *In-situ X-ray studies during deformation of rubber toughened amorphous polymers*. Poster session presented at MaTe Poster Award 1996 : first annual poster contest.

Document status and date:

Published: 01/01/1996

Document Version:

Accepted manuscript including changes made at the peer-review stage

Please check the document version of this publication:

- A submitted manuscript is the version of the article upon submission and before peer-review. There can be important differences between the submitted version and the official published version of record. People interested in the research are advised to contact the author for the final version of the publication, or visit the DOI to the publisher's website.
- The final author version and the galley proof are versions of the publication after peer review.
- The final published version features the final layout of the paper including the volume, issue and page numbers.

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In-situ X-ray studies during deformation of rubber toughened amorphous polymers



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Introduction

The toughness of brittle amorphous polymers can be improved by making the material locally extremely thin [1]. Therefore the ultimate objective of the present research is the development of ductile 'engineering foams' based on this class of polymers. Current research is focussed on:

- the preparation of nano-sized rubber morphologies
- the relation between these morphologies and the mode of microscopic deformation

Experimental

In-situ small angle x-ray scattering (SAXS) experiments during tensile testing were performed on PPO-rubber modified PMMA with nano-sized morphologies. The data were analysed as schematically presented in figure 1.

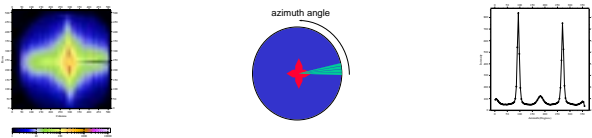


fig. 1 a) two dimensional SAXS pattern, b) integration over the azimuthal angle (divided in 90 bins, one bin is represented by a green triangle), c) azimuth angle vs integrated intensity

Results

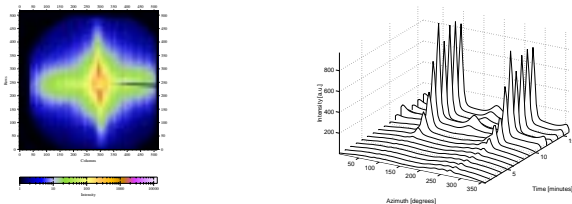


fig. 2 PMMA/PPO 90/10 a) SAXS pattern measured during final time frame, b) azimuth angle vs integrated intensity as function of deformation time

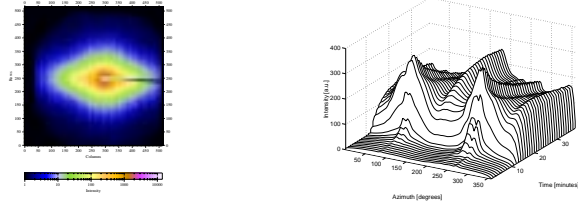


fig. 3 PMMA/PPO 80/20 a) SAXS pattern measured during final time frame, b) azimuth angle vs integrated intensity as function of deformation time

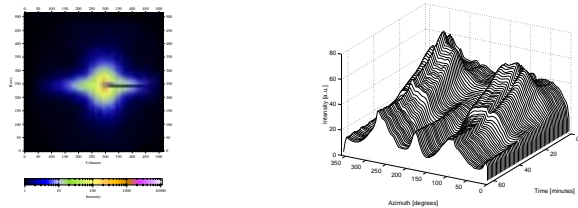


fig. 4 PMMA/PPO 70/30 a) SAXS pattern measured during final time frame, b) azimuth angle vs integrated intensity as function of deformation time

Conclusions

In-situ SAXS tensile test experiments are proven to be a powerful tool to characterize the microscopic mode of deformation. The observed x-ray patterns for the studied PMMA/PPO blends are attributed to crazing (90/10) [2], rubber cavitation followed by shear yielding (80/20) and shear yielding (70/30).

Acknowledgments

Dr. P. Boesecke (ID2-BL4 European Synchrotron Radiation Facility (ESRF), Grenoble, France), Dr. A. Hammersley (ESRF), J.G.P. Goossens, T. Buijs

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- [2] H.R. BROWN, E.J. KRAMER, *J. Macromol. Sci.-Phys.*, 1981, **B19**, 487.