Strain rate dependent toughness of rubber modified brittle amorphous polymers

Strain Rate Dependent Toughness of Rubber Modified Brittle Amorphous Polymers

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Introduction

Objective is to study the relation between the toughness and the microscopic mode of deformation in rubber modified brittle amorphous polymers at different strain rates. Therefore:

- PMMA/rubber blends with sub-micron sized morphologies are prepared via chemically induced phase separation.
- The microscopic deformation is studied using small angle x-ray scattering (SAXS).
- The toughness is determined for both tensile and impact deformation.

Results

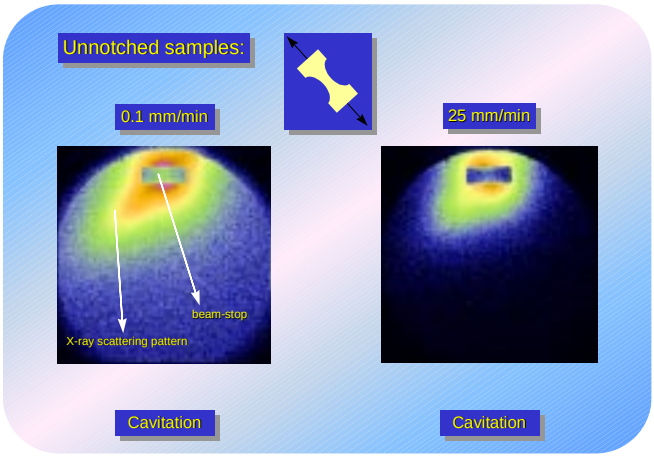

fig. 1 SAXS patterns of PMMA/rubber 80/20 blend showing cavitation for both strain rates.

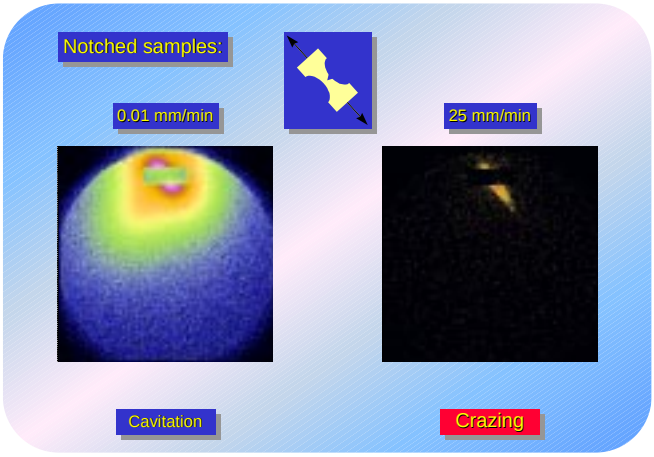

fig. 2 SAXS patterns of PMMA/rubber 80/20 blend showing a transition in microscopic deformation mechanism from cavitation to crazing with increasing strain rate.

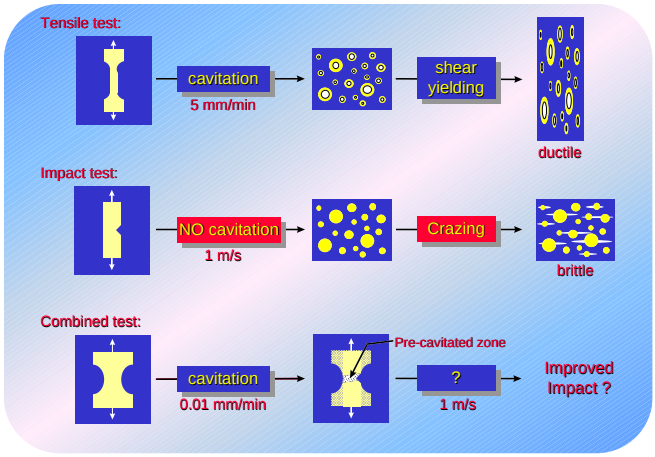

fig. 3 Overview of the mechanical tests and the mode of microscopic deformation determined by SAXS.

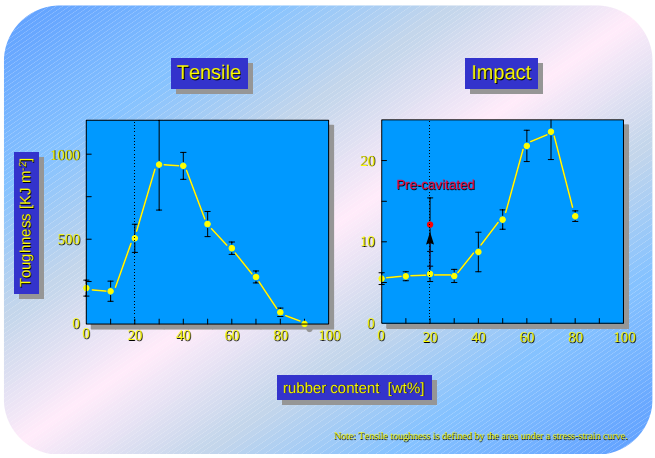

fig. 4 Macroscopic mechanical properties of the PMMA blends. The impact toughness of the 80/20 blend is enhanced by pre-cavitation of the impact sample in tensile deformation (combined test, see fig. 3).

Conclusions

- The PMMA/rubber 80/20 blend shows an improved tensile toughness but is still brittle in impact.
- This can be explained by the transition from cavitation to crazing at higher strain rates.
- The impact toughness can be improved in a combined test in which 'holes' are generated in tensile deformation prior to the impact test.