Experimental report

13/10/2015

Proposal: 9-11-1673 **Council:** 4/2014

Title: From nature to innovative self-healing materials:
The dynamics of a self-healing polyisoprene network

Research area: Soft condensed matter

This proposal is a new proposal

Main proposer: Barbara GOLD

Experimental team: Barbara GOLD

Local contacts: Peter LINDNER

Samples: polyisoprene

Instrument	Requested days	Allocated days	From	To
D11	3	2	28/11/2014	30/11/2014
IN15 Standard	7	0		

Abstract:

Double networks consisting of both permanent and transient cross-links are a new interesting class of materials which shows an extreme potential for applications with adaptive requirements. In the framework of a PhD thesis and EU-funded project SHINE we recently mastered the synthesis, rheology and the SANS characterization of such systems under equilibrium. This proposal therefore aims at the microscopic investigation of the associated underlying dynamics at the length scales of the chains by means of NSE (IN15) in isotropic state as well as a first assessment of the non-equilibrium behaviour under strain by SANS (D11).

-experimental report for experiment number 9-11-1673-

From nature to innovative self-healing materials

B. Gold, W. Pyckhout-Hintzen, A. Wischnewski, D. Richter

Double networks consisting of both permanent and transient cross-links are a new interesting class of materials which shows an extreme potential for applications with adaptive requirements. In the framework of a PhD thesis and EU-funded project SHINE we recently mastered the synthesis, rheology and the SANS characterization of such systems under equilibrium.

This experiment served as a first assessment of the non-equilibrium chain conformation under strain by SANS (D11) as well as a pre-test for a recently developed strain apparatus for elastomeric materials.

Model system:

Figure 1. Stepwise formation of a dual elastomeric network

Sample System measured:

h polyisoprene : d polyisoprene = 95 w% to 5 w%

M_w (polyisoprene) = 100 kg/mol (protonated and deuterated)

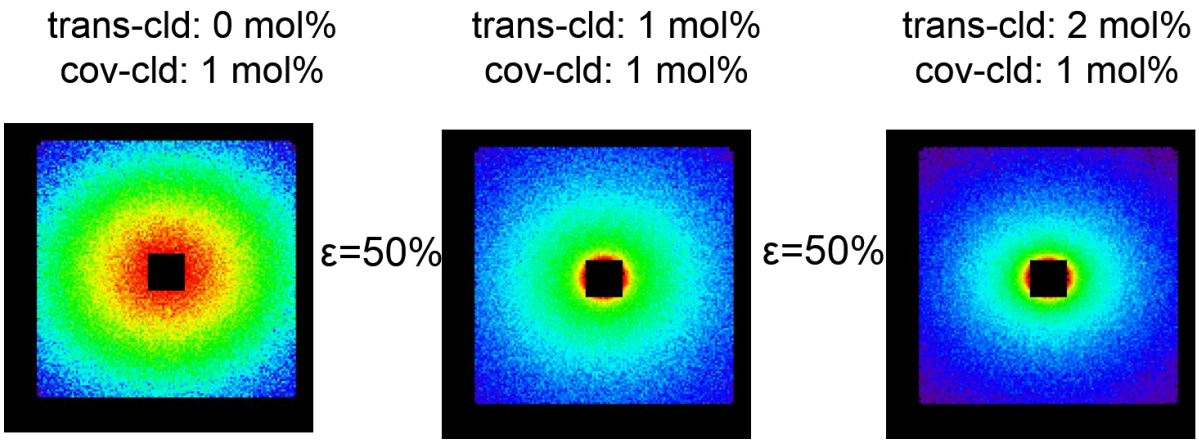
functionalization degree:
- 0 mol% (reference system, covalent cross-linked polyisoprene)
- 1 mol%, 2 mol% transient urazole groups

covalent cross linking density: 1 mol%

strain: 0 %, 0.5 %, 0.75 %
sample-to-detector distance: 1.2 m, 8 m, 20 m
temperature: AT

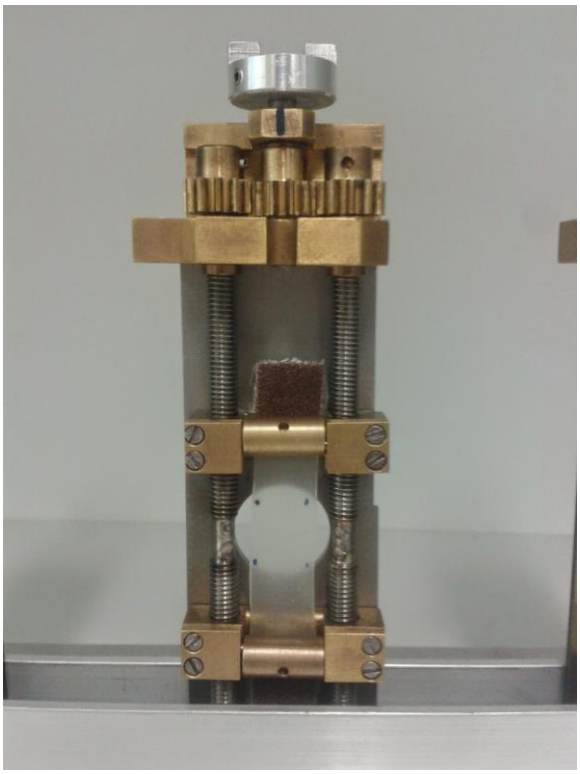
Results:

The following 2D intensity maps at a sample-to-detector distance of 8m show a comparison between the pure covalent and the functionalized network samples at ambient temperature under a strain of 50%.



Qualitatively the deformation of the samples can be seen from a slight elliptic shape of the density distribution. This effect seems to be more pronounced for the dual network samples as the total number of crosslinks in the system is increased.

The test of the strain apparatus worked out well as can be seen from the following picture.



Data evaluation and technical improvement of strain apparatus in progress.