# SANS AND NSE ON SELF-HEALING MODEL POLYMERS

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## ABSTRACT

Stimuli-responsive polymers, which are materials with precise and dynamically tuneable physical properties, have become a major field of investigation over recent years. One of the most current additions to this field are self- healable polymers [1,2,3]. Model compounds consisting of homoditopic mixtures A…A / B…B, like key-lock systems where A-B contacts are exclusively built, were recently studied by means of neutron scattering. The pre-polymer was polypropylene(glycol)(PPO). By chemical modification of the end groups with Thymine-1-acetic acid (Thy) (A) and Diaminotriazine (Triaz) (B) three reactive sites of hydrogen bonding lead to the formation of aggregates.

SANS measurements in deuterated toluene confirmed the existence of long chains in the Thy-Thy /Triaz-Triaz mixture. Radius of gyration ($R_g$) and the molecular weight of the kinetic chain increased with decreasing temperature. NSE measurements, performed in the same conditions, revealed that the dynamics also slowed down upon association. All data were analyzed in terms of the Zimm model [4] for polymer dynamics in solution taking into account the structural information obtained by SANS. It was unambiguously proven that dynamic neutron scattering is probing the aggregation by H-bonding mechanism by the significant change of the dynamic behavior, For the first time such an association process in solution has been observed on the nanosecond time scale by quasielastic neutron scattering.

## REFERENCES

[1] P. Cordier, F. Tournhilhac, C. Soulié-Ziakovic, L. Leibler, Self-healing and thermoreversible rubber from supramolecular assembly, *Nature* **451**, 2008, pp. 977-980.

[2] D. Montarnal, P. Cordier, C. Soulié-Ziakovic, F. Tournilhac, L. Leibler, Synthesis of self-healing supramolecular rubbers from fatty acid derivatives, diethylene triamine and urea, *Journal of Polymer Science, Part A: Polymer Chemistry* **46**, 2008, pp. 7925- 7936.

[3] D. Montarnal, F. Tournilhac, M. Hidalgo, J. L. Couturier, L. Leibler, Versatile one-pot synthesis of supramolecular plastics and self-healing rubbers, *Journal of American Chemical Society* **131**, 2009, pp. 7966- 7967.

[4] B. H. Zimm, Dynamics of Polymer Molecules in Dilute Solution: Viscoelasticity, Flow Birefringence and Dielectric Loss, *Journal of Chemical Physics* **24**, 1956, pp 269-279.