Photo-reversible solid to liquid transition of azobenzene containing polymers

David Siniscalco,[a] Laurence Pessoni,[b] Laurent Billon,[b] Anne Boussonnière,[a] Anne-Sophie Castanet, Nicolas Delorme,[a,*]

a Institut des Molécules et Matériaux du Mans (IMMM) – UMR CNRS 6283 – Le Mans Universi-té, Avenue Olivier Messiaen, 72000 Le Mans, France

b Bio-Inspired Materials Group: Functionalities & Self-Assembly, Universite de Pau et des Pays de l'Adour, E2S UPPA, 2 avenue Angot, 64000 Pau, France

* Nicolas.delorme@univ-lemans.fr

Mots-clés : Smart polymer – nanomechanic – adhesive – structure/properties

Résumé :

Azobenzene containing polymers (azopolymers) can exhibit a photo-reversible solid to liquid transition illustrated by a cyclic softening and hardening of the polymer material upon irradiation. Such behavior gives the opportunity to address potential applications in healable coatings, smart adhesives,[1] and more recently in energy conversion and storage[2] Unfortunately, existing methods to characterize this transition are scarce and mainly qualitative impeding a comprehensive understanding of the parameters.

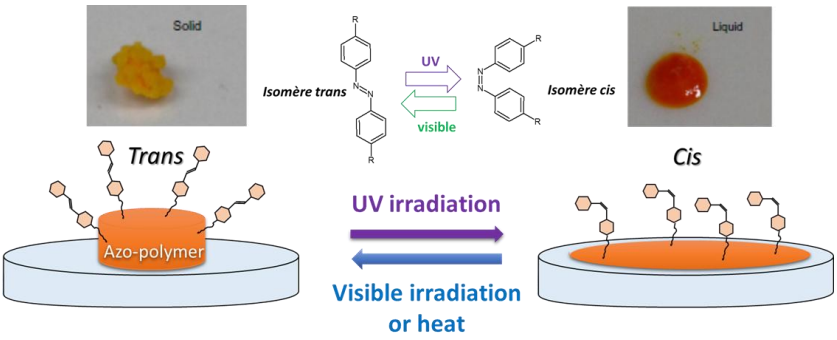

Photo-reversible solid to liquid transition for an azopolymer

To unravel the structure–property relationship associated with this transition, we designed azopolymers with various azobenzene groups and different molecular weight. Our findings indicate that both the molecular weight and chemical structure of the azopolymer significantly influence the isomerization and the solid-to-liquid transition.[3] Innovatively, we employed a method based on Atomic Force Microscopy to demonstrate that the photo-induced solid to liquid transition can be quantitatively characterized by a transition temperature (T_{SL}) similar to a nematic-isotropic transition for liquid crystal.[4] This approach allows us, for the first time, to systematically study the physical parameters that influence this transition. These results open up opportunities to optimize azopolymer materials specifically for applications as a photo-controllable adhesive.[5]

Références :

[1] a) W.-C. Xu, S. Sun, S. Wu, *Angewandte Chemie International Edition* **2019**, *58*, 9712-9740; b) L. Pessoni, N. Delorme, L. Billon, *European Polymer Journal* **2021**, *156*, 110608.

[2] C. Wallace, K. Griffiths, B. L. Dale, S. Roberts, J. Parsons, J. M. Griffin, V. Görtz, *ACS Applied Materials & Interfaces* **2023**, *15*, 31787-31794.

[3] L. Pessoni, D. Siniscalco, A. Boussonnière, A.-S. Castanet, L. Billon, N. Delorme, *European Polymer Journal* **2022**, *174*, 111297.

[4] D. Siniscalco, L. Pessoni, L. Billon, A. Boussonnière, A.-S. Castanet, J.-F. Bardeau, P. Nickmilder, P. Leclère, N. Delorme, *ACS Applied Polymer Materials* **2023**, *5*, 7358-7363.

[5] D. Siniscalco, L. Pessoni, A. Boussonniere, A.-S. Castanet, L. Billon, G. Vignaud, N. Delorme, *Coatings* **2024**, *14*, 275.