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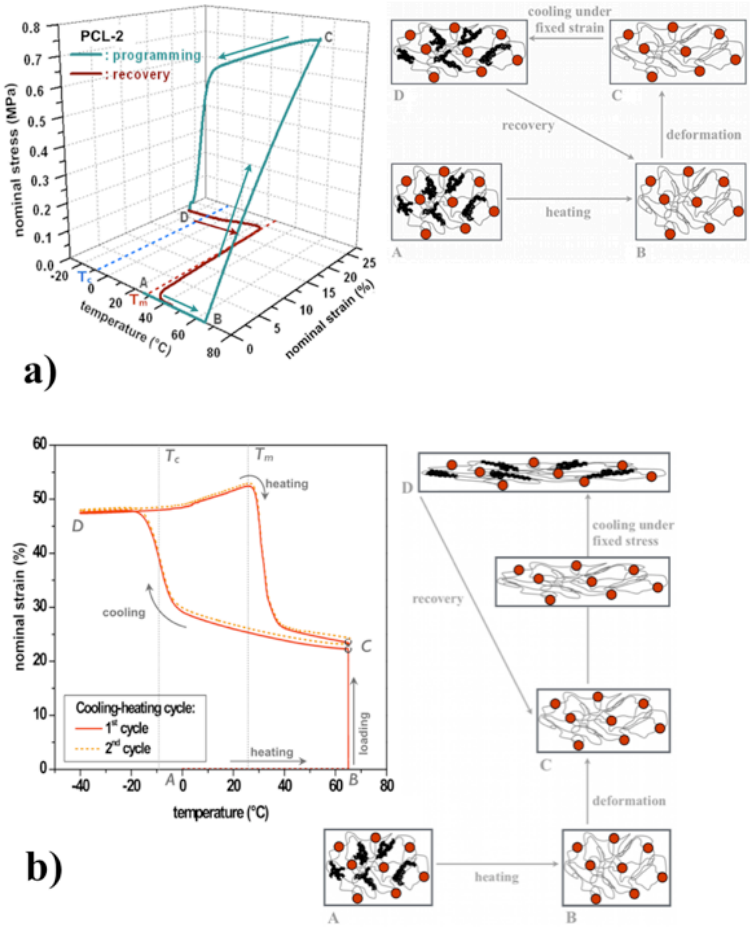
Shape memory behavior of semicrystalline polymer networks: thermo-mechanical characterization and structure-property correlation

The shape memory effect of polymers is based on a proper combination of material features (time-delayed viscoelastic recovery; rubber elasticity) and specific thermo-mechanical histories. Further, in order to enhance/tailor their performances, shape memory polymers (SMPs) are synthesized with proper macromolecular architectures, typically consisting of chains, acting as “thermal switches”, bridged by “net-points”, responsible for the shape memory. SMPs are typically grouped in four classes, distinguished by the type of “switching” temperature (either glass transition or melting temperature) and by the type of net-points (either physical or chemical crosslinks). Among these families, chemically crosslinked semicrystalline polymers are considered an interesting type of SMPs, for two reasons: i. their one-way shape memory behaviour occurs as a fast process triggered by a specific temperature; ii. they are one of the few types of polymers capable of a two-way shape memory effect [1]. This interesting behaviour is a consequence of the structural evolution that acts as driving force for the shape memory effect, and that involves melting/crystallization of the crystalline phase. In this presentation, on the basis of experimental results on semicrystalline networks based on poly(ε-caprolactone) [1-2], the peculiar behaviour of this class of SMPs is described and interpreted, providing insight on the role played by the structure on the shape memory response.



References

[1] S. Pandini, F. Baldi, K. Paderni, M. Messori, M. Toselli, F. Pilati, A. Gianoncelli, M. Brisotto, E. Bontempi, T. Riccò, “One-way and two-way shape memory behaviour of semi-crystalline networks based on solegel cross-linked poly(ε-caprolactone)”, Polymer, 54 4253-4265, 2013.

[2] S. Pandini, D. Dioni, K. Paderni, M. Messori, M. Toselli, E. Bontempi and T. Riccò, “The two-way shape memory behaviour of crosslinked poly(e-caprolactone) systems with largely varied network density”, Journal of Intelligent Material Systems and Structures, 27(10), 1388–1403, 2016.

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February 15th, 10:00am
DICAr MS1 Meeting Room
Via Ferrata, 3 – Pavia