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Newsletter Elasto-Plast

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Content

Additionnal information

http://hdl.handle.net/20.500.12210/33863

Scientific publication of our work

Contact us

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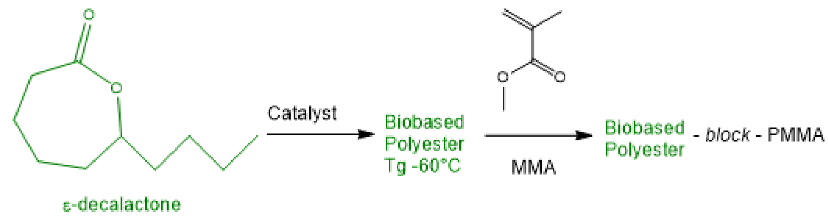
2nd generation TPE

An important part of the Elasto-Plast project is devoted to the conception and design of second-generation thermoplastic elastomers (TPE), *i.e* with a new molecular structure. This is done by means of new catalytic systems, or by considering new combinations of monomers and polymers. This notably includes biobased polar TPE. The use of biomass as an alternative raw material is interesting for replacing fossil resources whose stock is decreasing, but also for the development of new innovative and more efficient products.

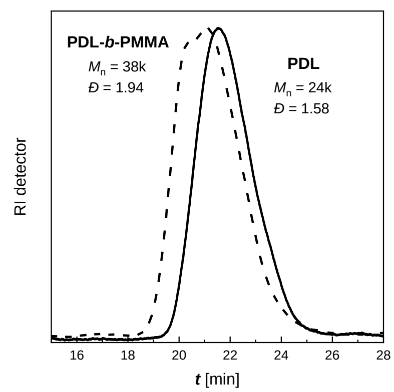
We have produced two types of second-generation TPE in which the soft block is bio-based, and the hard block is based on PMMA (poly methyl methacrylate).

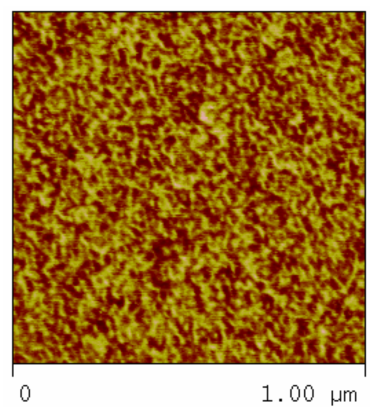
TPE PMMA – Biobased polyester

The first biobased TPE that we have produced is based on decalactone. Decalactones come from oilseed biomass. They are formed from fatty acids, and are used in the flavor and fragrance industry. They are starting to emerge in the field of polymers. We used ε-decalactone, that comes from ricinoleic acid from castor oil. Its crowded structure makes it not very reactive for polymerization. We have developed a catalytic system which does not include metals and which is capable of subsequently polymerizing ε-decalactone and methyl methacrylate (sequential block copolymerization).



The block copolymer has a number-average molecular weight of 40,000 g / mol. The atomic force microscopy image shown below shows that it nanostructures at room temperature, with soft and hard domains.





The mechanical behavior of the PDL- *block* -PMMA copolymer is shown in the figure below, with a tensile modulus of about 8.5 MPa, a strain at break of 200% and stress levels before break of about 2 MPa. These values correspond to those generally observed for other common TPE. To complete the mechanical characterization, a recovery test was also carried out. When stretched to 70% strain, the material exhibits an almost instantaneous recovery rate of 50% comparable to results reported for thermoplastic elastomers based on polyolefins. This new TPE shows promise for applications requiring good adhesion to PMMA or other polar thermoplastics, and could be an alternative to PDMS in transparent plastic PMMA-type microfluidic devices. The results of our study have been published and can be viewed at the following link : http://hdl.handle.net/20.500.12210/33863

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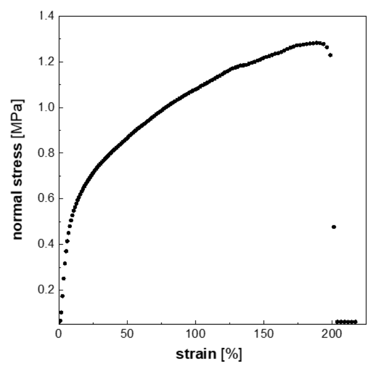
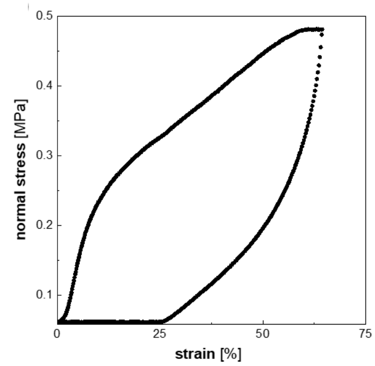


Tensile testing



Recovery experiment

The next steps could consist of making a triblock copolymer with a central block of PDL or making the soft block from another biobased lactone.

TPE PMMA – Biobased methacrylate

The second type of biobased TPE is based on lauryl methacrylate. It is a biobased methacrylate available on the market. It is made from lauryl alcohol, which is a fatty alcohol made from palm kernel oil (not to be confused with palm oil) or coconut oil. Poly (lauryl methacrylate) (PLMA) and PMMA-based TPE are known to exhibit poor mechanical properties. Here we have introduced methyl methacrylate units into the soft block in an effort to improve these properties. Thus, the soft block is a random poly (lauryl methacrylate - *co* - methyl methacrylate) copolymer rich in lauryl methacrylate in order to maintain a low glass transition temperature. We used a catalytic system described in the literature to do this reaction.

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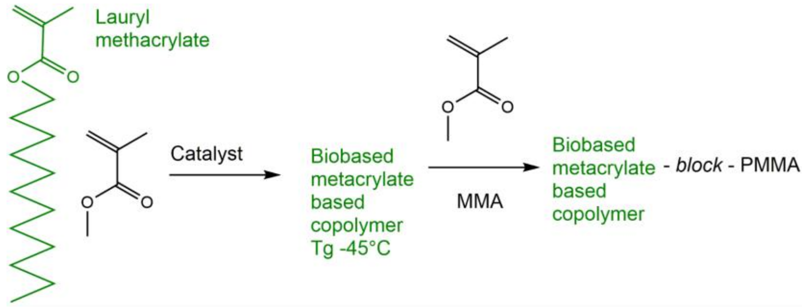
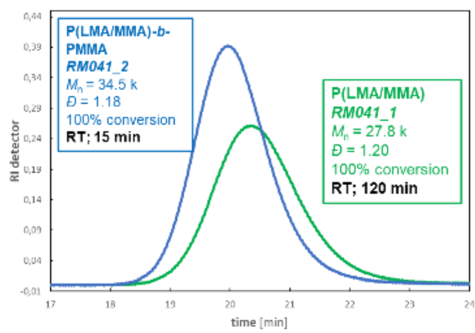
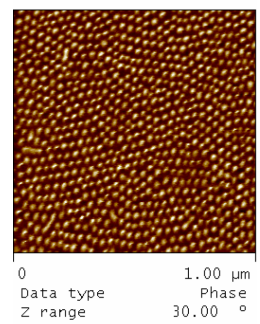
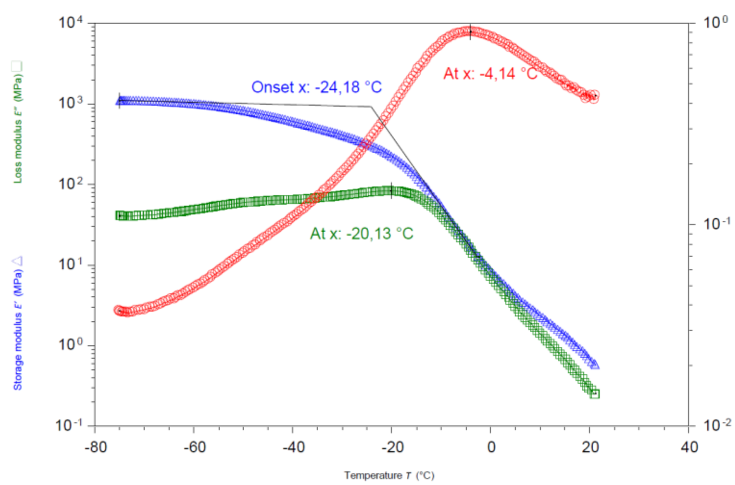


The block copolymer has a number average molar mass of 35,000 g / mol. The atomic force microscopy image shown below shows that it nanostructures at room temperature, with soft and hard domains.





The dynamic mechanical analysis of the new TPE is presented below. There is a tan δ peak close to 1 around room temperature, which suggests good damping properties.



The mechanical behavior in traction is also presented in the

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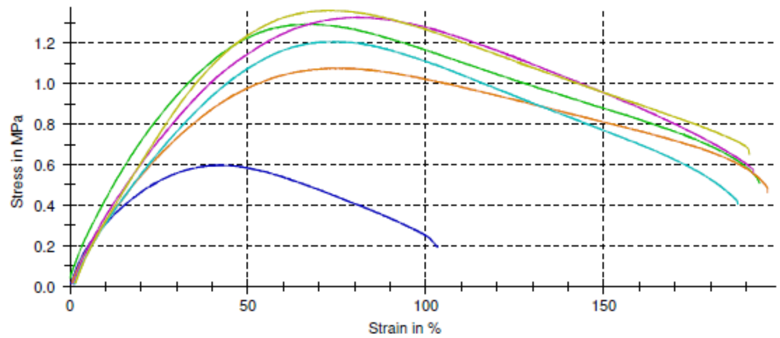
figure below. We can note a very low rigidity (on average less than 1 MPa) and a low tensile strength (1.2 - 1.3 MPa), but the elongation is quite high (180%). These properties, to which must be added a very important tackiness, make it a good candidate for making dressings for corns or blisters. A demonstrator is being designed.



The next steps would be the realization of a triblock copolymer, the measurement and optimization of the tackiness as well as the insertion of an antimicrobial component into the new TPE.

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