PRESS RELEASE – PARIS – 24 MAY 2022

Toward new degradable polymers

- A research team has synthesized new degradable polymers by integrating fragile linkages in their structure.
- They degrade in water much faster than the polymers currently considered the gold standard.
- A number of potential applications are on the horizon, ranging from the biomedical sector to water treatment.

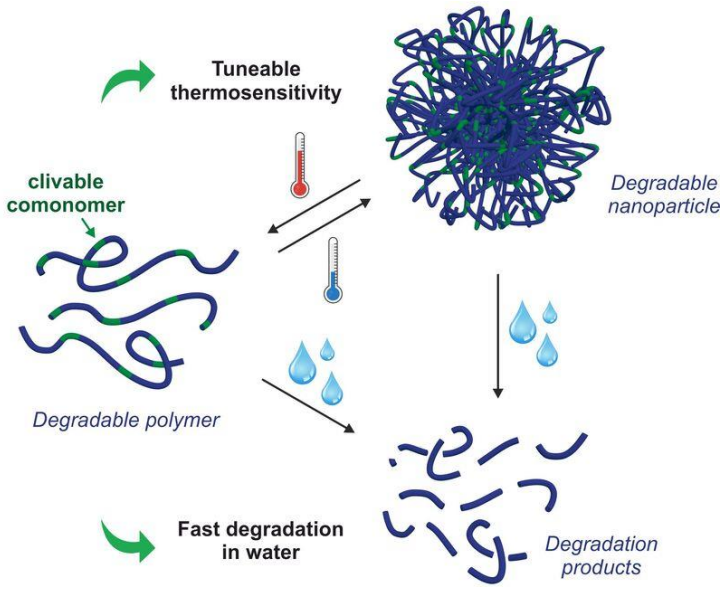
Plastics are highly flexible and possess multiple uses, but also have a major problem, their degradation. Most take a considerable amount of time to decompose in nature. In a new study published in *Nature Communications* on 24 May 2022, a team of researchers from the CNRS and l'Université Paris-Saclay has developed new polymers that degrade in water in the record time of one week.

Vinyl polymers, commonly referred to as "plastics," are ubiquitous materials. They are extremely interesting for their ease of synthesis and their great diversity in terms of architecture and functionality. However, their non-degradability raises major environmental problems[1], highly limiting their use in biomedical applications.

Thanks to a new polymerization technique[2] that can create macromolecules with a controlled and homogenous architecture, the team of Julien Nicolas[3], a CNRS researcher at l'Institut Galien Paris-Saclay (CNRS/Université Paris-Saclay), has synthetized a very easily degradable polymer material. By inserting a fragile monomer[4] in polyacrylamide—a polymer widely used in many industrial sectors—the latter can, depending on the nature of the monomer added, either become water-soluble, or feature solubility that adjusts depending on the temperature, especially near that of the human body.

How degradable are they? In water they can degrade by over 70% in a week, as opposed to months and even years for today's leading biodegradable polymers, such as PLA or PCL[5].

Thanks to the characteristics of these new polymers and their ease of synthesis, the research team believes they can be used to administer medicine, namely by formulating these polymers as thermosensitive nanoparticles that can solubilize at the temperature of a human body. Such chemistry should also pave the way for degradable surfactants for water treatment via flocculation[6], a process commonly used in potable water treatment plants.



These new polymers, which can be thermosensitive, rapidly degrade under the effect of water. © *Julien Nicolas*

Notes

[1] See the conference: Plastic Pollution: From Assessment to Solutions, Research Mobilized (in French)

[2] Controlled radical polymerization.

[3] These results were obtained as part of the THERMONANO project led by Julien Nicolas, and financed by the European Research Council (ERC).

[4] Molecules, most often organic, that react with one another to form long polymer chains.

[5] PLA=polylactic acid, a biodegradable polymer generally made from corn starch. PCL=polycaprolactone, a biodegradable polymer.

[6] Flocculation is a process used in water treatment consisting of an agglomeration phase (possible thanks to the addition of a flocculant) and a decantation phase for the aggregates obtained.

Bibliography

Vinyl Copolymers with Faster Hydrolytic Degradation than Aliphatic Polyesters and Tunable Upper Critical Solution Temperatures. Amaury Bossion, Chen Zhu, Léa Guerassimoff, Julie Mougin and Julien Nicolas. *Nature Communications*, 24 may 2022. DOI: 10.1038/s41467-022-30220-y

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