

Researchers find important solution for making new strong and durable plant-based plastics

Overcoming the low reactivity of biobased, secondary diols in polyester synthesis

AMSTERDAM, 14 December 2022 – Researchers at the Industrial Sustainable Chemistry group of the University of Amsterdam led by Avantium Chief Technology Officer Gert-Jan Gruter have found an important solution towards the production of fully plant-based, rigid polyesters. The study has recently been published in the prestigious scientific journal *Nature Communications* (<https://www.nature.com/articles/s41467-022-34840-2.pdf>). The group presents a simple, yet innovative, synthesis strategy to overcome the inherently low reactivity of plant-based secondary diols in polyester synthesis, resulting in polyesters that have superior mechanical and thermal properties, and at the same time high molecular weights. This enables the production of new very strong and durable plant-based plastics from building blocks such as Avantium's FDCA (furandicarboxylic acid), thereby further increasing its addressable market.

In collaboration with Avantium and LEGO, the University of Amsterdam research group found a way to incorporate substantial amounts of rigid bio-based diols such as glucose-derived isosorbide (to arrive at a strong and durable material) while making sufficiently long polymer chains (to achieve a certain ductility). This makes it possible to produce very strong sustainable plastics from chemical building blocks (monomers), such as FDCA to make PEIF – (poly(ethylene-co-isosorbide furanoate) or terephthalic acid to make PEIT – (poly(ethylene-co-isosorbide terephthalate)). These new plastics also have superior heat resistance compared to conventional plastics, which is relevant for refill or re-use as washing of bottles takes place at 85°C. The isosorbide-based polymers furthermore show promising barrier and mechanical properties that can outperform common fossil-based materials such as ABS (Acrylonitrile Butadiene Styrene) and Tritan.

For more than 15 years, Avantium has been working on plant-based polyesters. Its lead product is PEF (polyethylene furanoate) and Avantium is currently constructing the world's first commercial facility for the manufacture of FDCA, the key building block for PEF. In its laboratories, Avantium is continuously looking for further improvements or variances of PEF. The new polymer PEIF is complementary to PEF and as such increases the potential market for FDCA, as PEIF serves as an equivalent to ABS and Tritan. In collaboration with the University of Amsterdam, Avantium currently has eight PhD students and Post Docs working in its laboratories conducting this kind of research with Avantium.

The research described in the *Nature Communications* paper was carried out within the RIBIPOL project funded by the Dutch Research Council NWO. Avantium supported the project by hosting the PhD students of the research group in its laboratories. First author of the paper is PhD student Daniel Weinland, who defended his PhD thesis on 27 October 2022 and now works for Avantium. Avantium acquired the resulting intellectual assets from the University. Moreover, LEGO supported the project as part of the search for non-fossil alternative plastic materials.

Paper details

Daniel H. Weinland, Kevin van der Maas, YueWang, Bruno Bottega Pergher, Robert-Jan van Putten, BingWang, Gert-Jan M. Gruter: Overcoming the low reactivity of biobased, secondary diols in polyester synthesis. *Nat Commun* **13**, 7370 (2022). <https://www.nature.com/articles/s41467-022-34840-2>

About Avantium

Avantium is a leading technology development company and a frontrunner in renewable chemistry. Avantium develops novel technologies based on renewable carbon sources as an alternative to fossil-based chemicals and plastics. The company currently has three technologies at pilot and demonstration phase. The most advanced technology is the YXY[®] plant-to-plastics-technology that catalytically converts plant-based sugars into FDCA (furandicarboxylic acid), the key building block for the sustainable plastic PEF (polyethylene furanoate). Avantium has successfully demonstrated the YXY[®] Technology at its pilot plant in Geleen, the Netherlands, and has started construction of the world's first commercial plant in 2022, with planned large-scale production of PEF in 2024. The second technology is Ray Technology[™] and catalytically converts industrial sugars to plant-based MEG (mono-ethylene glycol) and plant-based MPG (mono-propylene glycol): plantMEG[™] and plantMPG[™]. Avantium is scaling up its Ray Technology[™] and the demonstration plant in Delfzijl, the Netherlands opened in November 2019. The third technology is called the Dawn Technology[™] that converts non-food biomass into industrial sugars and lignin in order to help transition the chemicals and materials industries to non-fossil resources. In 2018, Avantium opened the Dawn Technology[™] pilot biorefinery in Delfzijl, the Netherlands. Avantium also provides R&D solutions in the field of sustainable chemistry and is the leading provider of advanced catalyst testing technology and services to accelerate catalyst R&D. Avantium works in partnership with like-minded companies around the globe to create revolutionary renewable chemistry solutions from invention to commercial scale.

Avantium's shares are listed on Euronext Amsterdam and Euronext Brussels (symbol: AVTX). Avantium is incorporated in the Euronext Amsterdam SmallCap Index (AScX). Its offices and headquarters are in Amsterdam, the Netherlands.

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