Xylose and other natural sugars as building blocks towards more sustainable polymers and functional materials

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Abstract

The intensive use of polymers has brought challenges associated with their overwhelming reliance on fossil-fuel resources, limited end-of-life options and environmental persistence. Towards a circular economy, our vision for sustainable polymers involves creating materials derived from renewable feedstocks and with multiple closed-loop life cycles. However, one major challenge is to obtain materials with adequate properties. Towards this goal, our team has been investigating the incorporation of monosaccharide units into synthetic polymer backbones, to create renewable materials with attractive attributes, including degradability and advanced functionalities.

This talk will first describe the design of bio-derived monomers from natural monosaccharides such as xylose and mannose, as well as from deoxyribonucleosides, and their polymerisation using techniques such as ring-opening (co)-polymerisation (ROP and ROCOP) [1-3], acyclic metathesis polymerisation (ADMET) [4], and thiol-ene polymerisation [5]. Throughout our studies, we have refined our understanding of the structure/properties relationship of those sugar-based polymers, which form a promising, tuneable [6], bio-derived and degradable materials platform. The first steps taken towards their commodity and specialty applications will be presented (e.g., UV-degradable films [7], solid polymer electrolytes [8], hydrogels, amorphous solid dispersions [9]).

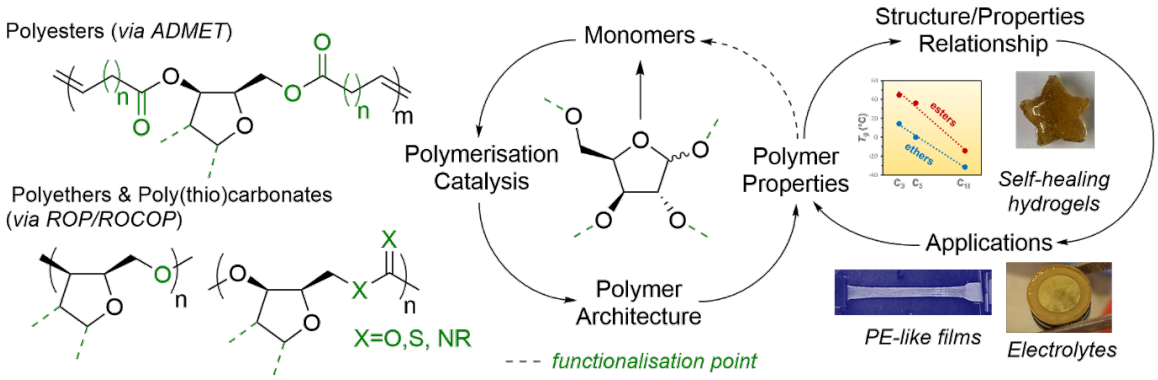

Figure 1. Examples of xylose-based polymers and applications.

References

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[3] *Polym. Chem*. **2023**, *14*, 2838–2847.
[4] *ACS Appl. Polym. Mater*. **2021**, *3*, 5870–5881.
[5] *ACS Appl. Polym. Mater.* **2024**, *6*, 1622–1632.
[6] *Polym. Chem.* **2024**, *15*, 3149–3156.
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Biography

Antoine Buchard is Professor of Sustainable Polymer Chemistry at the University of York, where he and his team moved in April 2024. Prior to this position he was Professor of Chemistry at the University of Bath. He began his independent research career at Bath as a Whorrod Research Fellow in 2013, before being awarded a Royal Society University Research Fellowship in 2017 and promoted to Reader (2019) then Professor (2023). While at Bath Antoine was also one of the Associate Directors (Sustainable Chemical Technologies) of the University of Bath Institute for Sustainability.

Originally from France, Antoine graduated from the Ecole Polytechnique, where he also completed his PhD, under the supervision of Prof. Pascal Le Floch and Dr Audrey Auffrant (2009). He then moved to the UK and worked at Imperial College London as a postdoctoral research assistant in the group of Prof. Charlotte K. Williams FRS. Antoine returned to France in 2011 and gained industrial R&D experience, working for Air Liquide on Carbon Capture, Storage and Utilisation (CCSU) projects.