Carbohydrate foldamers and assemblies

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Pedeferri Room
Venue Leonardo I Building 6

Politecnico di Milano
P.zza Leonardo da Vinci, 32
Milano

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Speaker

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Natural biopolymers have inspired the development of synthetic analogues – i.e. foldamers – capable of adopting defined conformations and forming programmable three-dimensional architectures. These compounds are mainly based on peptides and nucleic acids, that are well understood at the molecular level. In contrast, the complexity of carbohydrate synthesis and structural analysis have prevented access to synthetic carbohydrates capable of adopting defined geometries. In the Delbianco group, we synthesize well-defined carbohydrates to understand how the primary sequence affects conformation and aggregation.[1-2]

Building on this fundamental knowledge, we present the rational design and synthesis of glycans adopting stable secondary structures, challenging the common belief that glycans are not capable of folding due to their flexibility. For example, by combining natural glycan motifs, we created a glycan hairpin, a secondary structure not present in nature.[3]

Moreover, we designed glycan sequences that assemble into programmable supramolecular architectures, from fibers and particles to hydrogels.[4]

Analogous to how the discovery of peptide-based foldamers launched a new field, we anticipate that carbohydrate foldamers and assemblies may find applications in areas across materials science, biology, and catalysis.[5-6]

References:

1. X. Wu, M. Delbianco, K. Anggara, T. Michnowicz, A. Pardo-Vargas, P. Bharate, S. Sen, M. Pristl, S. Rauschenbach, U. Schlickum, S. Abb, P. H. Seeberger, K. Kern, Nature 2020, 582, 375-378.

2. G. Fittolani, D. Vargová, P. H. Seeberger, Y. Ogawa, M. Delbianco, J. Am. Chem. Soc. 2022, 144, 12469-12475.

3. G. Fittolani, T. Tyrikos-Ergas, Y. Yu, N. Yadav, P.H. Seeberger, J. Jiménez-Barbero, M. Delbianco, Nat. Chem., 2023, 15, 1461-1469.

4. N. Hribernik, D. Vargová, M.C.S. Dal Colle, J. Hui Lim, G. Fittolani, Y. Yu, J. Fujihara, K. Ludwig, P.H. Seeberger, Y. Ogawa, M. Delbianco, Angew. Chem. Int. Ed., 2023, e202310357.

5. S. Djalali, N. Yadav, M. Delbianco, Towards glycan foldamers and programmable assemblies, Nat. Rev. Mater., 2024, 9, 190-201.

6. K. Liu, M. Delbianco, A glycan foldamer that uses carbohydrate–aromatic interactions to perform catalysis. Nat. Chem., 2025, https://doi.org/10.1038/s41557-025-01763-6

Martina Delbianco *is a leading chemist in the field of carbohydrate chemistry, glycomaterials, and synthetic oligosaccharides. She earned her MSc in Chemistry from the University of Milan and completed her PhD at Durham University under the supervision of Prof. David Parker. Since 2018, Martina is Group Leader of the "Carbohydrate Materials" group at the Max Planck Institute of Colloids and Interfaces. Her research focuses on the chemical synthesis of complex carbohydrates and the development of precision glycomaterials with programmable structure, folding, and function. By combining glycan assembly, synthetic methodology, and advanced structural characterization, Delbianco has introduced strategies to control carbohydrate architecture with atomic-level precision, enabling new insights into carbohydrate folding and molecular recognition. She has received multiple prestigious recognitions, including the ERC Starting Grant in 2022.*

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