TOR VERGATA
UNIVERSITÀ DEGLI STUDI DI ROMA

Dipartimento di Scienze e Tecnologie Chimiche

AVVISO DI SEMINARIO

Il giorno 5 Novembre alle ore 12:00

in Aula Stella

Il dott. **Muhammad Ghufran Rafique**

University of Cambridge

terrà un seminario dal titolo

Sequence matters: soft matter assembly from the polymers of life

Proponente: Prof. F. Ricci

Via della Ricerca Scientifica, 1
www.stc.uniroma2.it

Tel. 06 72594337
Email: chimica@uniroma2.it

Sequence matters: soft matter assembly from the polymers of life

Chemical information, in the form of polymer sequence, is fundamental to the existence and propagation of life. Nucleic acids are sequence-defined polymers that encode and transfer genetic information, enabling protein synthesis. Chain folding in proteins, in turn, is sequence-dependent and crucial for healthy biological function.

Manipulation of sequence information enables the creation of bio-inspired and biomimetic materials for future applications, including tissue engineering, the construction of soft robotic systems, and the development of therapeutics capable of targeting diseases beyond the reach of conventional drugs. Concurrently, control over sequence can facilitate the development of ever more complex protocells – the plausible primitive precursors of modern cells – with the goal of recreating Earth's chemical past and addressing fundamental questions about the origins of life.

In this talk, I will focus primarily on the former design objective. I will introduce the field of DNA nanotechnology, which has expanded the role of DNA sequence beyond the storage and transfer of genetic information: DNA sequences can now be used to dictate folding and higher-order structure formation, much like amino acid sequences in proteins, enabling the creation of complex, hierarchical soft matter assemblies. However, this approach is not without limitations. I will discuss how these limitations can be overcome by combining DNA with non-nucleosidic chemical groups to create hybrid DNA block copolymers with an expanded chemical sequence space. These hybrids can exploit additional non-covalent interactions to form nanostructures in a predictable manner. This, in turn, enables the construction of dynamic biomimetic materials whose unique sequences encode their self-assembly behavior, thereby emulating processes observed in natural systems.

Finally, I will discuss some of our recent results on peptide/nucleic acid coacervate protocells, which underscore the importance of considering a prebiotic system that complements, if not supplants, the RNA world hypothesis in models for the emergence of life on Earth.

1. M. G. Rafique, Q. Laurent, M. D. Dore, H. H. Fakih, T. Trinh, F. J. Rizzuto and H. F. Sleiman, *Acc. Chem. Res.*, 2025, **58**, 177–188.
2. M. G. Rafique, Y. Wu, Y. Shi, Q. Laurent, A. Elmanzalawy, C. Saab, Y. Shi, D. F. Perepichka, J. Li and H. F. Sleiman, *Angew. Chemie Int. Ed.*, 2025, **64**, e202501441.
3. Dore, M. D., Rafique, M. G., Yang, T. P., Zorman, M., Platnich, C. M., Xu, P., Trinh, T., Rizzuto, F. J., Cosa, G., Li, J., Guarné, A. & Sleiman, H. F. *Nat. Commun.* **15,** 4384 (2024).
4. M. Ghufran Rafique, J. M. Remington, F. Clark, H. Bai, V. Toader, D. F. Perepichka, J. Li and H. F. Sleiman, *Angew. Chemie Int. Ed.*, 2023, **62**, e202217814.
5. F. J. Rizzuto, M. D. Dore, M. G. Rafique, X. Luo and H. F. Sleiman, *J. Am. Chem. Soc.*, 2022, **144**, 12272–12279.