Università degli Studi di Napoli Federico II

PhD in Biotechnology - 38th cycle

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Bionanomaterials for biomedical applications: design and synthesis of Peptide Nucleic Acid nanomaterials.

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Synthetic oligonucleotides are extremely useful and well-known tools used to interact with nucleic acids, as they mimic the structural motif of the DNA investigated[1]. Among them, Peptide Nucleic Acid (PNA) is a DNA/RNA mimic in which the phosphate deoxyribose backbone is replaced by uncharged N-(2-aminoethyl)-glycine and the nucleobases are linked to the glycine amino group through methylene carbonyl bond. PNAs are able to recognize complementary DNA/RNA sequences by canonical Watson-Crick and combined Hoogsteen base-pairing rules. The most important difference between PNA and DNA/RNA is that PNA shows a neutral net charge. This allows hybridized PNA:DNA and PNA:RNA complexes to establish more stable bonds between bases than their corresponding counterparts. Furthermore, they can prevent with greater success non-specific electrostatic interactions between the uncharged PNAs and charged peptide portions. Moreover, PNAs are not substrates of either nucleases or proteases. PNA is a powerful biomolecular tool showing many promising applications in biotechnology. Considering the remarkable properties of these molecules, which outperform traditional oligonucleotides, they have been proposed as a valuable alternative to ON-based probes in gene-sensor design[2]. Based on this evidence, this project aims to use PNAs, opportunely modified to enable their combination with nanostructured materials, to further investigate the biological target from a pharmacological and diagnostic point of view. More precisely, the immobilization of PNA on composite nanomaterials[3] could be useful not only for the fishing-out of

prognostic markers but also as a scaffold for the design of new eco-friendly and biocompatible biomaterials with several fields of application. This project involves the knowledge of manual synthesis and of structural characterization using UV-Vis, circular dichroism (CD), Fourier-transform infrared spectroscopy (FT-IR) and NMR spectroscopies. The materials to be functionalized range from porous silicon to diatomite, commercially available or produced in collaboration with specialized research groups in Naples or in other Italian or foreign universities. This research project will be carried out in partnership with the IRCCS SYNLAB SDN Research Institute, which will provide the organic/inorganic nanomaterials for testing and selecting the most suitable substrate to achieve the biosensing platform.

References

1. *Chandrasekaran, Arun R.; Rusling, David A. (**2017**). Nucleic Acids Research.*
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3. *C. Diaferia, G. Morelli and A. Accardo. (**2019**). J. Mater. Chem. B.*