VERSATILE MACROMOLECULES AND THEIR BIOMEDICAL APPLICATIONS

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Polymer reaction and colloidal engineering have reached a level of maturity allowing us to synthesize macromolecules and small particles covering very wide and often even overlapping ranges of sizes and compositions. On the other hand, the number of potential applications in various areas is very large, and the limiting step is probably mostly in our capability to imagine a “certain” structure to solve a “certain” problem. In this presentation we discuss through a number of examples, how to define the properties that a material should have to solve a certain problem, and then how to synthesize the corresponding macromolecule.

In particular, we focus on a class of polymers exhibiting a comb-like structure, where the pendants have a chemical composition, length and order along the backbone that can be accurately controlled through controlled free radical polymerization techniques. Each pendant is prepared before hand through living techniques, including ring-opening polymerization, which allows preparing macromonomers with very different properties in terms of hydrophilicity, hydrophobicity, biodegradability, etcetera. The result is a very versatile macromolecule that can be adapted to provide the specific functionalities, including self-assembly and nanoparticle stabilization, needed to solve a particular problem.

Specific applications will be discussed mainly in the area of drug delivery and tissue engineering. Starting from the specific problem to be solved, the desired properties of the appropriate macromolecules are discussed and the corresponding synthesis process is described. Finally, an outlook on different application areas is provided.