Polypeptides from novel approaches in polymer chemistry

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Proteins are natural building blocks that have many features still unrivaled by their synthetic counterparts, including chemical diversity, hierarchical structure, specific chemical modification, programmed system dynamics, etc. Combined with their possible metabolism in living systems (biodegradation, etc.), these properties make proteins very interesting for designing new materials. In this respect, a major challenge is to optimize their production (extraction, recombinant protein) but their large-scale preparation from living systems still remains difficult. Alternatively, the most economical and efficient route to polypeptides is a chemical methodology: the ring-opening polymerization (ROP) of amino acid N-carboxyanhydride (NCA) monomers (figure 1).[1] Compared to proteins, peptidic polymers are much simpler macromolecules in which amino acids are statistically repeated. However, those polypeptides combine advantageous features of synthetic polymers (solubility, process, rubber elasticity, etc.) with those of natural proteins (secondary structure, functionality, biocompatibility, etc.).[2] NCA polymerization still suffers from significant limitations including tedious monomer purification steps, significant sensitivity to moisture, and processing in toxic solvents. Recent progresses have been impressive: efforts have focused on promoting the polymerization without the use of a catalyst, exploring more reactive initiators, and using heterogeneous processes including emulsion polymerization.[3] In this context, this talk will illustrate 1) how the combination of coordination chemistry or DNA binding to polypeptide polymers can be used to prepare smart polymeric systems,[4] 2) how aqueous ROP of NCA monomers can be extended to a PISA process,[5] and 3) how polymerization of NCA can afford simplified analogues of antimicrobial peptides.[6]

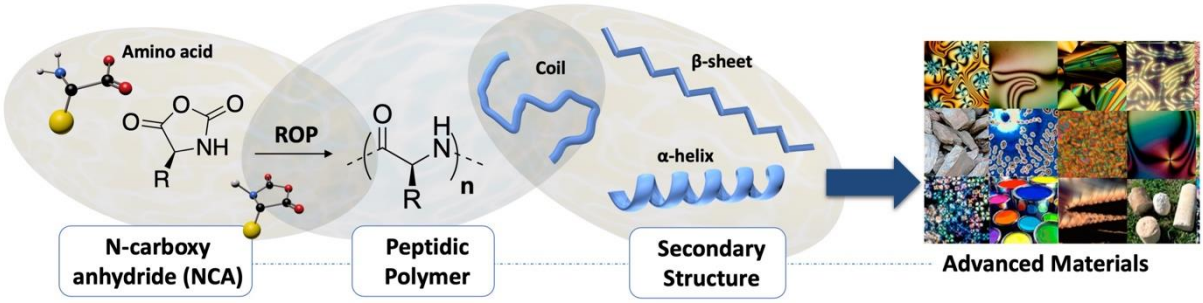

Figure 1. Peptidic polymers are ideal analogues of proteins to design advanced materials.

References

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