Non-natural protein expression

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During the last fifty years several advanced polymerization techniques have been developed to achieve precise control of molecular structure, from living anionic polymerizations to complex molecular machines. However, the ability of Nature to synthesize long chains of sequence-defined nucleic and amino acid polymers is still unrivalled. Indeed DNA, RNA, and proteins are examples of monodisperse and information-rich macromolecules whose folding and structure depend on tightly controlled primary structures.

Taking advantage of highly efficient biosynthetic machinery we expressed in a Cell-Free system two monodisperse and information-rich synthetic oligomers composed of a peptide backbone and non-natural lateral chains [1, 2]. Such molecules have the same chemical composition but different building blocks sequence.

Our aim is to polymerize more complex sequences of non-natural amino acids as well as to learn from Nature how to disassemble the polymer building blocks down to free monomers and reassemble them into a new material having same chemical composition but different properties [3]. This goal will be attempted in order to demonstrate the natural inspired chemical recyclability of such materials.

[1] Y. Shimizu, A. Inoue, Y. Tomari, T. Suzuki, T. Yokogawa, K. Nishikawa, T. Ueda, *Nature biotechnology*, **2001**, *19*, 751-755.
[2] M. C. Hartman, K. Josephson, J. W. Szostak, *Proceedings of the National Academy of Sciences*, **2006**, *103*, 4356-4361.
[3] P. F. Teixeira, B. Kmiec, R. M. Branca, M. W. Murcha, A. Byzia, A. Ivanova, J. Whelan, M. Drag, J. Lehtiö, E. Glaser, *Nature chemical biology*, **2017**, *13*, 15-17.