DNA Block Copolymers: From Synthesis to Interactions with Living Cells

Fikri E. Alemdaroglu, Andreas Herrmann*

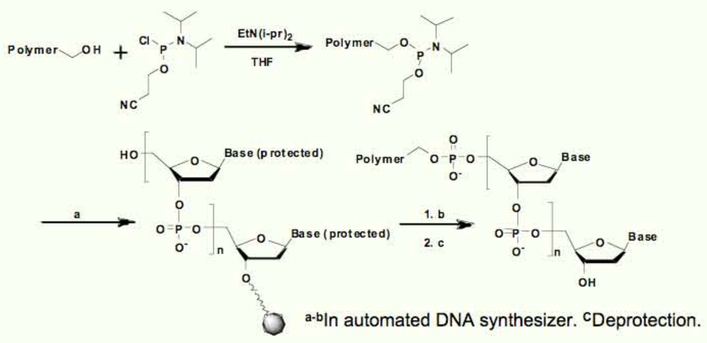
Max Planck Institute for Polymer Research, Ackermannweg 10 55128 Mainz, Germany
Email: andherrm@mpip-mainz.mpg.de

The combination of synthetic polymers and DNA has provided biologists, chemists and materials scientists with a fascinating new hybrid material. The challenges in preparing these molecular chimeras were overcome by different synthetic strategies that rely on coupling the nucleic acid moiety and the organic polymer in solution or on solid supports. The morphologies and functions of the bioorganic block copolymers can be controlled by the nature of the synthetic polymer segment as well as by the sequence composition and length of the DNA. Recent developments have expanded the scope and applications of these hybrid materials in a number of different areas including biology and medicine, as well as bio- and nanotechnology. Their usage ranges from gene delivery through to DNA detection to programmable nano-containers for DNA-templated organic reactions.

Synthesis

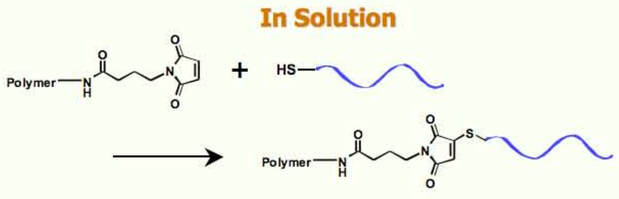
Diblock Copolymers

On Solid Support

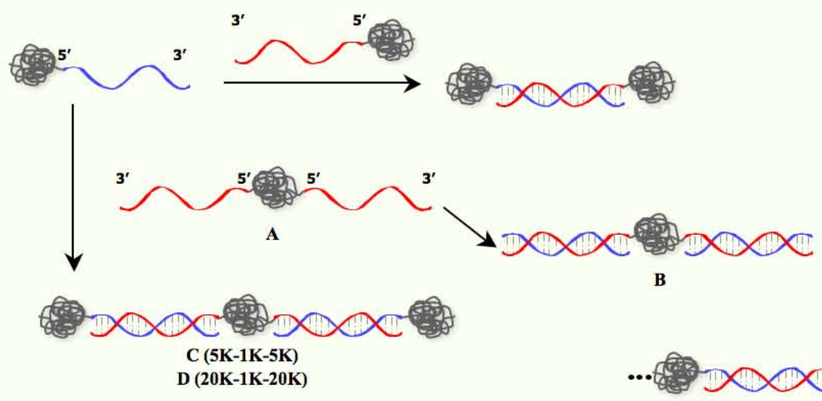


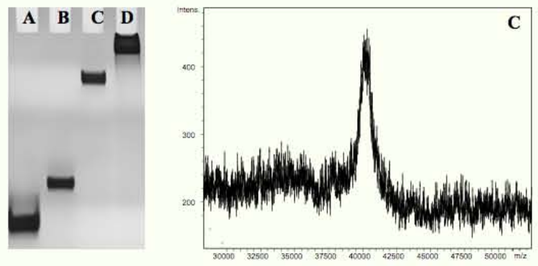
[a-b]In automated DNA synthesizer. [c]Deprotection.

In Solution

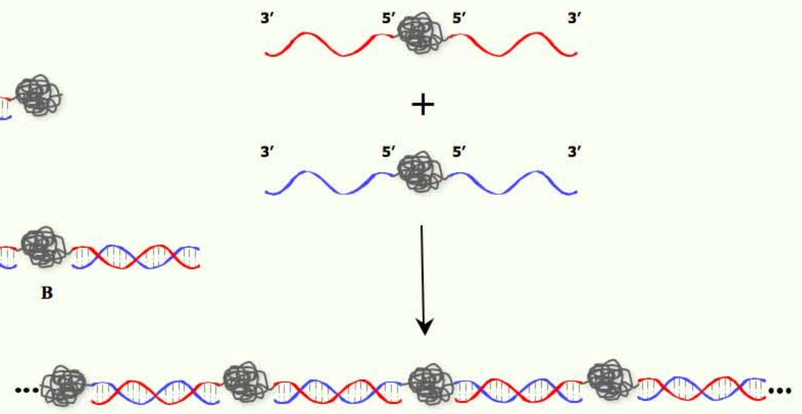


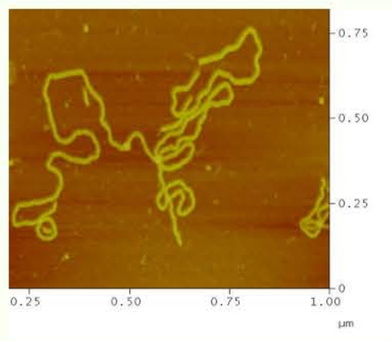
Tri- and Pentablock Copolymers





Multiblock Copolymers





Alemdaroglu, Ding, Berger, Herrmann, *Angew. Chem., Int. Ed.* **2006**, *45*, 4206.

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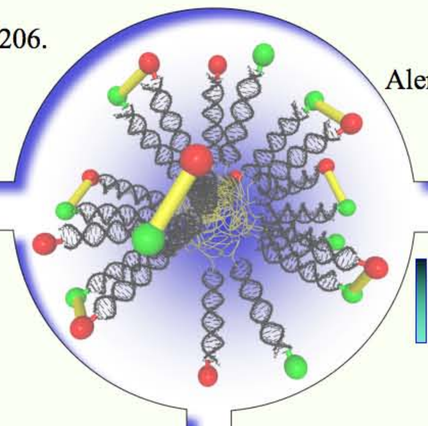
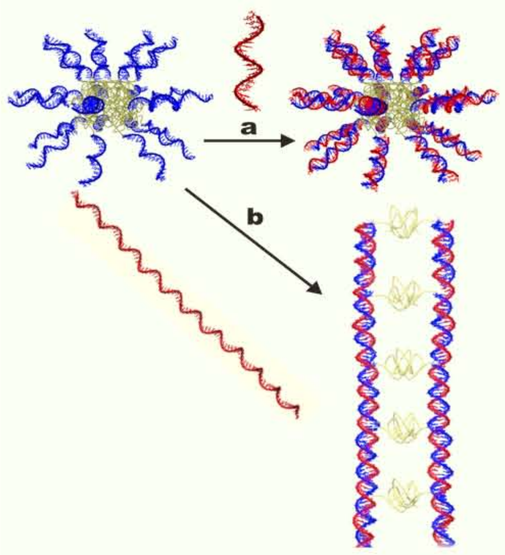
Safak, Alemdaroglu, Li, Ergen, Herrmann, *Adv. Mater.* **2007** *19*, 1499.

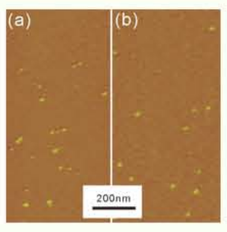


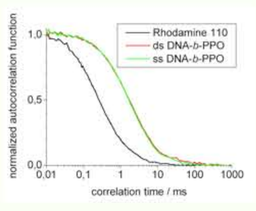
Alemdaroglu, Safak, Wang, Berger, Herrmann *Chem. Commun.* **2007**, *13*, 1358.

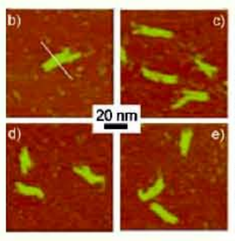
Self-Assembly

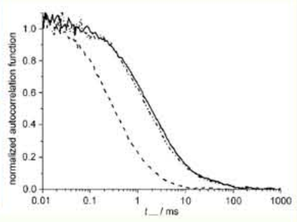
Engineering the Structural Properties of DNA Block Copolymer Micelles







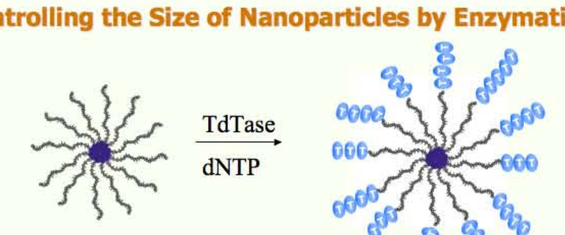


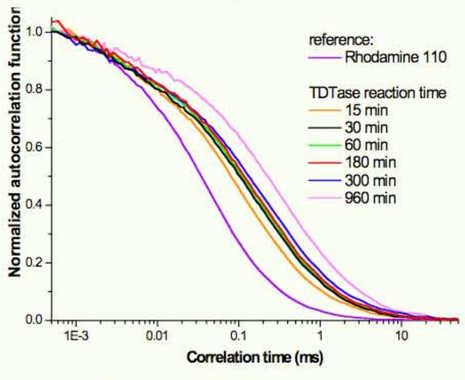


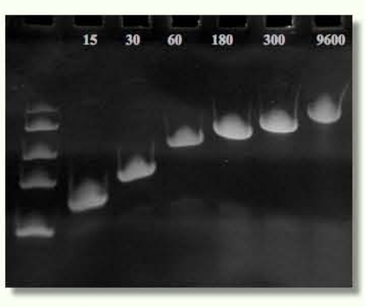
AFM **FCS**

Ding, Alemdaroglu, Börsch, Berger, Herrmann, *Angew. Chem., Int. Ed.* **2007**, *46*, 1172.

Controlling the Size of Nanoparticles by Enzymatic Reaction







Enlargement of micelles by FCS

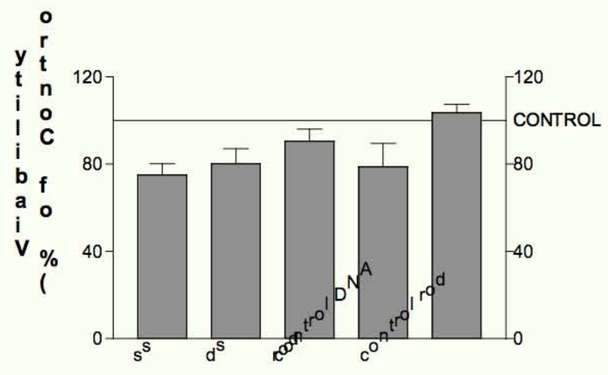
Growth of micelles compared with a DNA-b-PPO ladder

Further proof by AFM.

Alemdaroglu, Wang, Börsch, Berger, Herrmann, submitted

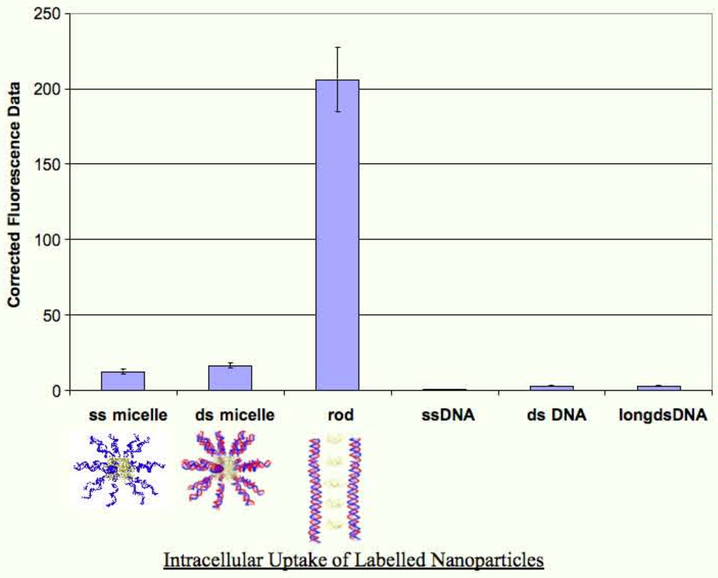
Interactions with a Human Cell Line

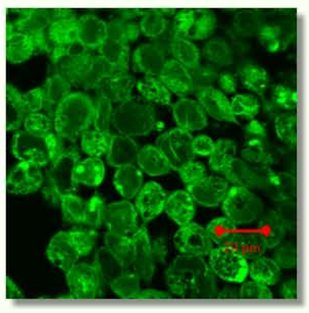
Toxicity of Nanoparticles



XTT based cell proliferation assay

Shape Matters: Cellular Uptake of DNA Block Copolymer Micelles





CLSM Image of Caco-2 Cells with Internalized Rod-like micelles

Intracellular Uptake of Labelled Nanoparticles

Alemdaroglu, Alemdaroglu, Langguth, Herrmann, *submitted*

This work was done in collaboration with N. Ceren Alemdaroglu, Prof. Peter Langguth, Dr. Rüdiger Berger, Dr. Ding Ke, Jie Wang, Dr. Kolaian Koynov and Dr. Michael Börsch.