

DNA-ferrocene as two-step-mechanophore & PEG-DNA as a model mechanophore

Emilie JEAN-PIERRE

Stimuli-responsive polymers are materials that change their properties in response to external stimuli (temperature, pH, enzyme, or redox potential), such as mechanophores, which change properties after external mechanical stress. They are used in a lot of applications such as, e.g., sensors, drug delivery, tissue engineering or catalysis.

Recently, ferrocene has proven to be a good mechanophore due to its stability under many conditions on one hand and its low binding energy compared to a C–C bond on the other. Associated with the unique and selective recognition capacity of the DNA base pairs, the first project focused on the functionalization of ferrocene moieties coupled to a DNA duplex for their embedment into a polymer (Fc-DNA-polymer). Thus, the ensemble of Fc-DNA-polymer should act as a mechanophore to preferentially dissociate under a trigger force, first opening the duplex, then releasing the iron ion in solution.

Electrophoresis and mass spectrometry were performed to follow the formation of Fc-DNA, then its introduction into polymers. Due to the complexity of the system, no promising results were observed during the polymer coupling to the DNA-ferrocene.

The second part of this work derived from the first project, exploiting the solubility of the polyethylene glycol (PEG). It was shown that DNA embedment in polymers is very efficient in aqueous environments.

Low and higher molecular weight PEG was used and substituted with single-stranded DNA. Two samples with complementary strands were synthesized and hybridized. Thus, a long polymer was formed with DNA and PEG and tested to be cleaved under sonication.

Again, electrophoresis and mass spectrometry analysis were performed to confirm the success of the polymer formation. The sonication experiment to prove that DNA can act as mechanophore required however the use of a large amount of polymer and hence DNA, which could not be achieved in fine.

Jury:

Prof. Dr. Katharina M. FROMM (thesis supervisor)

Prof. Dr. Robert Häner (external co-examiner)

Prof. Dr. Christian Bochet (internal co-examiner)

Prof. Dr. Marco Lattuada (president of the jury)