DNA as a supramolecular building block

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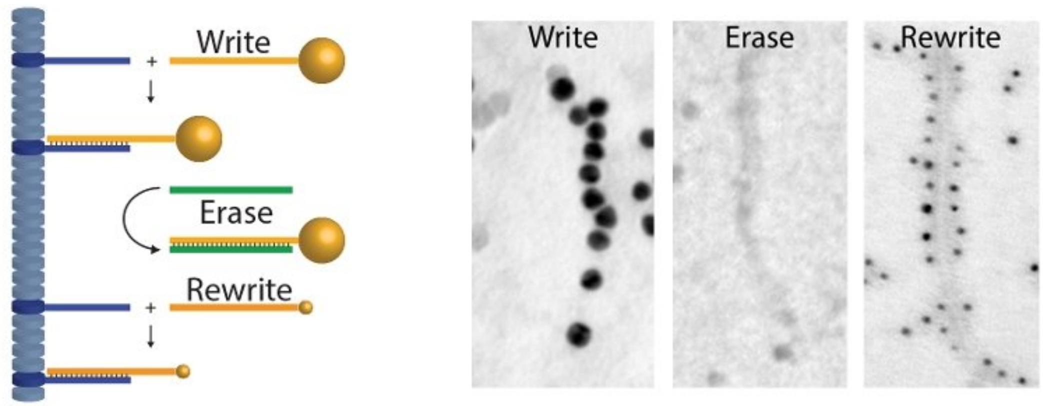

Credit: Leiden University

PhD student Willem Noteborn has investigated supramolecular structures. These can be useful for the loading of medicines and signalling molecules regarding, for example, cellular differentiation. In his thesis, he describes the functioning of these structures.

Noteborn: 'The goal of my research is making materials on a nanoscale, that eventually can form structures exceeding this small scale, visible to the naked eye. I've investigated how certain components form structures and the properties of those structures. That is the big theme of my thesis: supramolecular chemistry, intended for medical applications and diagnostics.'

Supramolecular polymers can be seen as chains of blocks that aren't covalently bound with for example hydrogen bonds or Van der Waals forces. Noteborn used individual polymer fibres, as well as larger networks in which he could, for example, grow cells. He has done a lot of research about superabsorbent hydrogels, made of this kind of polymers.

In different experiments Noteborn used DNA. He explains: 'I work with DNA a lot. Everyone knows DNA from its classical role in genetics and biotechnology. But I go many steps further than synthetic biology by seeing DNA as a building block.'

In nature, in double-stranded DNA the combinations of the complementary bases adenine and thymine and cytosine and guanine occur. Noteborn makes use of this property. 'You could attach adenine to a thymine and cytosine to a guanine, resulting in some kind of magnets. With these properties, you can do many cool tricks.'

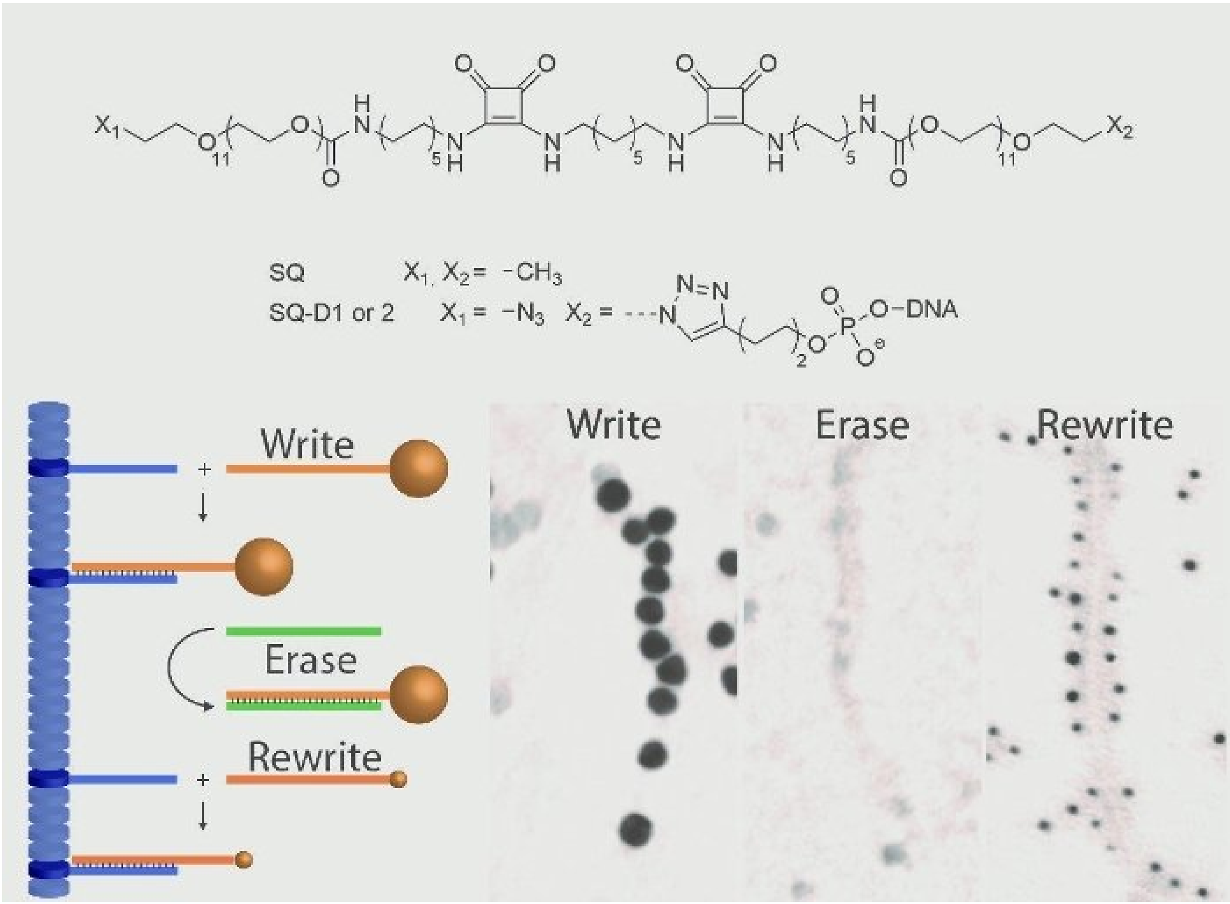

Figure 1; supramolecular polymer with DNA on which golden particles can be loaded selectively as a model system

In one of his model systems, Willem Noteborn used a supramolecular polymer with DNA-strains for selectively loading and releasing nanometre-size golden particles (figure 1). When these polymers are mixed with DNA-functionalized golden particles, they will bind to a DNA-strain on the polymer. Hereby, golden balls can be seen on the polymer. By adding a free, more complementary DNA-strain, the golden particles with DNA-strains will let go of the polymer because they will bind better to the free DNA than to the supramolecular polymer. Hereby, the golden balls cannot be seen anymore and afterwards, smaller golden balls can be loaded on the polymer.

Noteborn has always been interested in biology and chemistry. His father Mathieu Noteborn is professor in biochemistry at Leiden University. Willem Noteborn says: 'Since I was four years old I've been walking through the lab. The environment wasn't new to me. I had much admiration for Watson and Crick, two of the discoverers of DNA.'

Willem Noteborn obtained a bachelor's and a master's degree in Life Science & Technology. He first followed an internship with his later supervisor, Alexander Kros. After a biotechnological master internship at the research group of Gilles van Wezel about Streptomyces bacteria, he began his graduate research at Roxanne Kieltyka and Alexander Kros.

Social relevance plays a role in Noteborns research. He says: 'My research is fundamental, but it is necessary to eventually come with a social appliance. I think a lot of these kinds of model systems will not be applied directly, but many aspects can be implemented easily. We haven't done medical research yet.' But, he decides, the supramolecular chemistry is a fast-growing discipline. In the future, these systems will certainly be applied in medicines.

More information: Willem Noteborn will graduate the 11th of December on his thesis 'Supramolecular polymer materials for biomedical applications and diagnostics'.

Provided by Leiden University