Localized, DNA based logical circuits as components for biodetection

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Recent advances in the field of molecular programming [1,2] have shown that enzyme-free, DNA based circuits can be designed to perform the basic steps of molecular detection. Those include amplification and transduction of non nucleic-acid inputs. The implementation of these circuits as a set of bulk reactions faces difficulties which include leaky reactions and intrinsically slow, diffusion-limited reaction rates. In this presentation, I will consider simple examples of these circuits when they are attached to platforms (DNA origamis [3]). After discussing their thermodynamic properties [4], I will show that these platforms can be used to precisely control the interaction between different gates. As expected, constraining distances between gates leads to faster reaction rates. However, it also induces side-effects that are not detectable in the solution-phase version of this circuitry. In particular, strand displacement without toehold needs to be taken into account. Finally, I will present recent results showing how aptamers [5] can be interfaced with DNA origamis to generalize the triggering of DNA circuits by non nucleic-acid inputs.

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