DNA Origami Self-Assembly For Lithography

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Abstract:

Recent developments in DNA processing allow for the creation of unidimensional (1D), bidimensional (2D) or tridimensional (3D) nanostructures by means of DNA origami technology. These structures have nanometric precision and demonstrate high versatility, demonstrated by their use in fields as diverse as material science, nanomedicine and nanoelectronics. For nanoelectronics, research centered on the deposition and the immobilization of DNA origamis on mica or silica substrates. The DNA origami serves as an etch mask to transfer their motifs into silicon [1, 2]. Later, research extended to substrate-assisted self-assembly of DNA origamis on mica, to create highly ordered nanostructures [3]. The method is based on the exploitation of the interactions between the DNA origamis, the substrate and the divalent/monovalent cations.

The aim of this study is to create two square DNA origamis, which can self-assembled in 2D arrays by complementarity-shape directly on thermal SiO_2 substrates. The advantage of this method of self-assembly is that it exploits the low-energy π-π interactions present between square DNA origamis. Therefore, it is possible to create reversible hierarchical DNA nanostructures by increasing the Mg^{2+} concentration and controlling the temperature of the system [4]. Additionally, this reversibility offer the possibility to have potential spontaneous self-repairing properties in the 2D arrays as it has been demonstrated for the case of tubulin filaments [5]. I will present our latest results on the substrate-assisted self-assembly of these DNA origamis on thermal SiO_2 substrates. The 2D arrays created will be used as lithographic masks to make 2D silicon qubits arrays for quantum computing application.

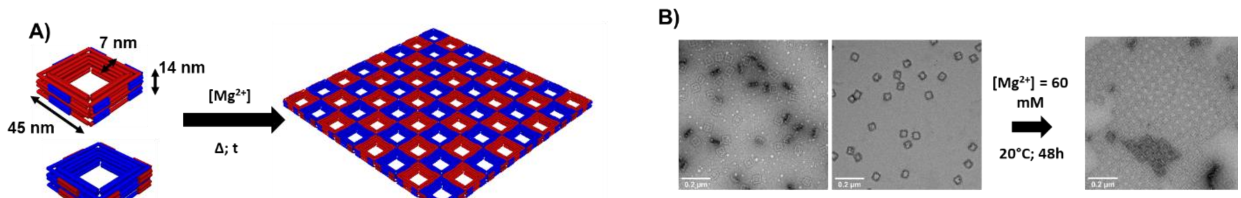

Figure 1 : A) 3D Modelization of the square monomers which can self-assembled by complementarity-shape in 2D arrays. B) TEM images of the complementary monomers and of a 2D array self-assembled with 60 mM of Mg^{2+} at 20°C during 48h.

References:

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[5] L. Schaedel *et al.*, *Nature physics*, **2019**, *15*, 830.