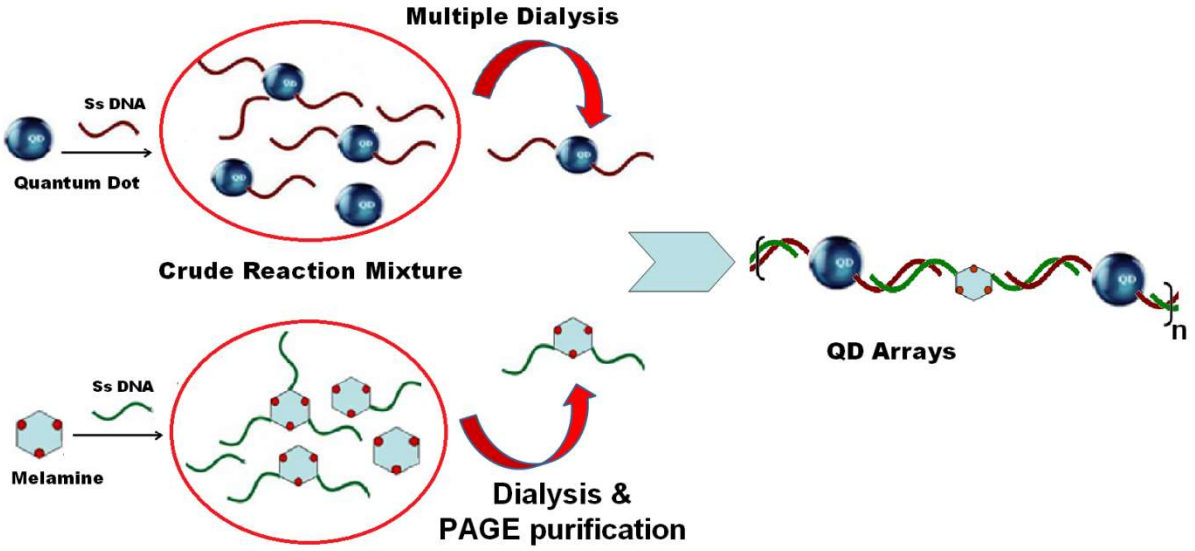
Quantum Dot – DNA array suitable for nanofabrication

Specific distribution of quantum dots QDs is a key requirement to explore their versatile uses in nanoelectronics and nanoplasmonic devices. The fabrication of QD-arrays on solid surface has been achieved through multiple methodologies for potential application in photo-voltaic devices. Here we have demonstrated the formation of ZnSe/ZnS QD-array in solution phase guided by the self-assembly with DNA–melamine hybrid molecules as described in the scheme below;



Scheme 1: Creation of Quantum Dot array templated by DNA-melamine hybrid molecules

Melamine was conjugated with ssDNA using phosphoramidate chemistry. Aqueous soluble ZnSe/ZnS QDs conjugated to complementary ssDNA was self-assembled with the DNA–melamine hybrid molecules by DNA-hybridization. The self-assembly leads to the precise positioning of the QDs in QDs array where the inter QD distance is being maintained by the DNA sequence length.

Direct observation of the QD arrays through self-assembly was made possible by atomic force microscopy (AFM) and transmission electron microscopy (TEM) studies.

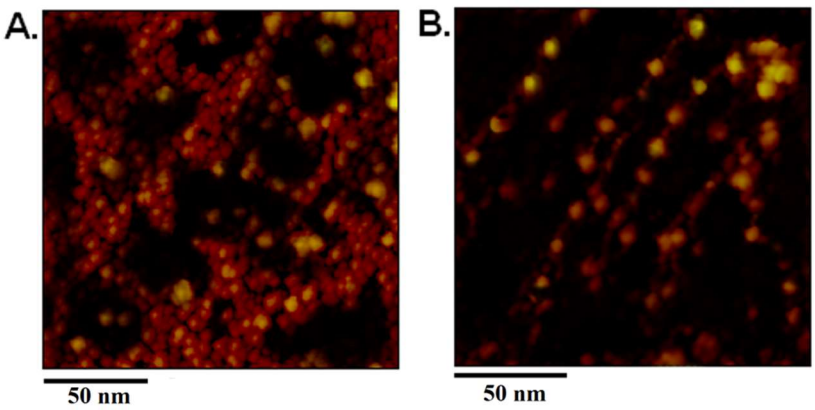


Fig. 1 AFM images (left) QD and (right) QD arrays

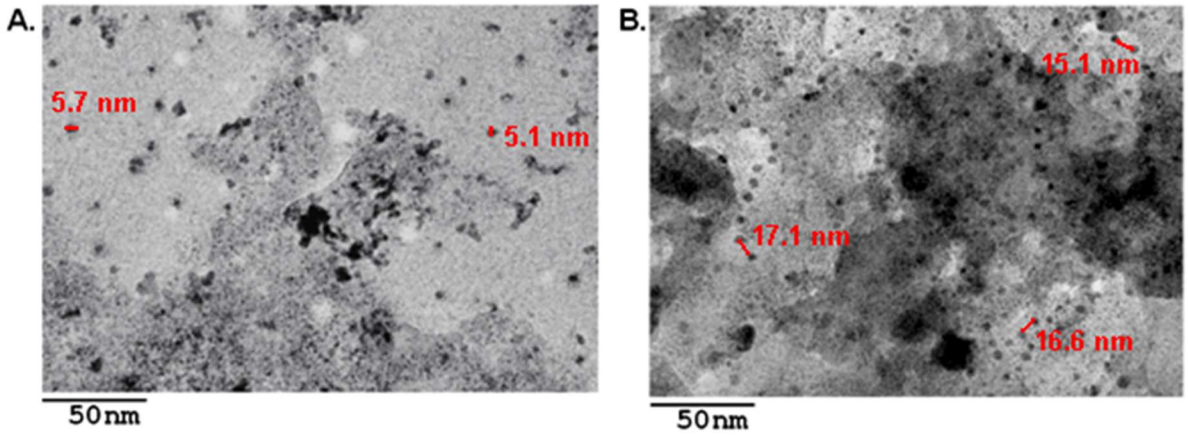


Fig. 2 TEM images (left) QD-$(R_1)_2$ and (right) QD arrays

The height profile of QD arrays shows the mean height of QDs in the range of 5-7 nm, separated by the distance of 15-17 nm, which is in agreement with TEM image of QD arrays.

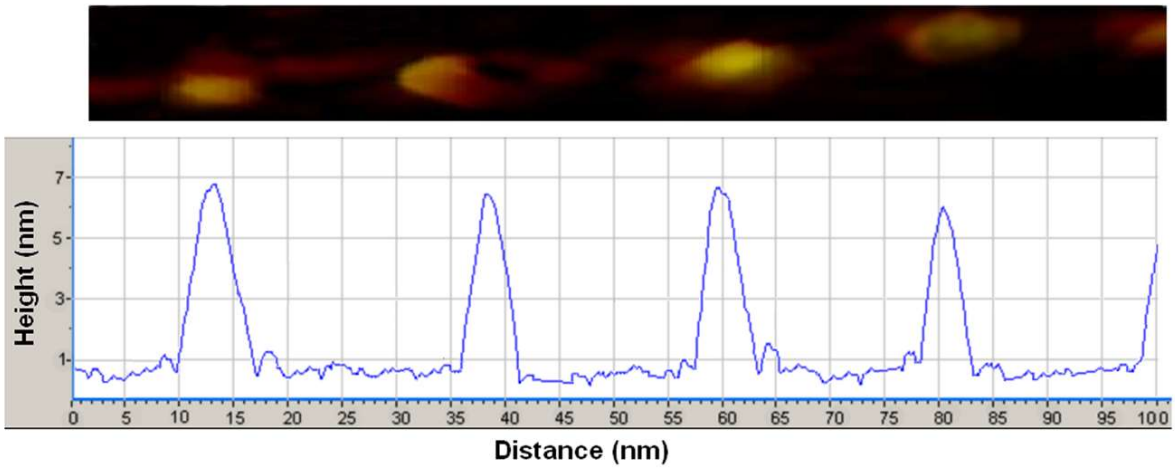


Figure 3: AFM height profile of QD arrays

It is possible to generate a network of QD-array in three-dimension also. These hybrid DNA–organic molecule-QD arrays can be used for potential nanofabrication applications using relevant analytical techniques.