TWO-DIMENSIONAL DNA NANOSTRUCTURES FORMATION THROUGH SELF-ASSEMBLY AT THE AIR/WATER INTERFACE

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The central dogma in Langmuir monolayers studies is that they are formed when amphiphilic molecules are deposited and spread spontaneously on the water surface to form a monomolecular film. A typical characteristic of these Langmuir monolayer forming molecules is that they are surfactants, with a hydrophilic head group and a hydrophobic chain, such as fatty acids, phospholipids, etc. In this talk, we will show that monomolecular films at the air/water interface can also be formed using water soluble molecules. For example, DNA is a highly charged polyelectrolyte and as such it is considered to be completely soluble in pure water. Surprisingly, we found that DNA can be trapped at the air/water interface and does not go back into a pure water subphase. Once at the interface, DNA molecules self-assemble into condensed nanostructures such as 2D foams, rings, disks and rods 2 nm thick. This condensation occurs without the presence of multivalent cationic ions, as it is required in bulk, for example in condensing DNA toroids. At high density, the molecules form a regular monomolecular network. At the interface, DNA is only partially immersed in water, which originates that the chains get only partially charged, but the charges are of the same sign. Therefore, this can be considered as another case of like-charge attraction, similar to those found in colloids trapped between glass plates and at the air/water interface. In addition, we found that DNA at the air/water interface can form 2D smectic-like domains. The 2D DNA nanostructures can be developed into different applications.

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