

Study of DNA in “glass like state” on different substrate by AFM

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An Atomic Force Microscope (AFM) operating at low temperature and under Ultrahigh Vacuum (UHV) conditions (10^{-7} - 10^{-9} mbar) with in situ tip/sample exchange is presented. The AFM uses the laser beam deflection method and it was developed for studying biological samples [1]. Based on X-ray crystallography, Mössbauer scattering and infrared spectroscopy measurements performed on several enzymes at low temperatures, there is a “glass like transition” at around 200 K below which the molecule should be in a more rigid state [2].

We extended the different DNA adsorption techniques known to work well at ambient conditions, to low temperatures application. We have imaged DNA plasmids adsorbed in the presence of divalent cations (Mg) on freshly cleaved mica

It is well documented [3] that HOPG surface treated by glow discharge technique possesses polar surface groups. The existence of polar groups renders the HOPG surface temporarily hydrophilic. The surface of HOPG was treated for 10–30 seconds in oxygen plasma. After treatment, the HOPG is hydrophilic and negatively charged, thus allowing easy spreading of DNA suspension.

All images were obtained with uncoated silicon cantilevers (NT-MDT Co.) nominal spring constant 0.12 N/m using setpoint 10mV which corresponds to the force around 500 pN at room temperature and consequently to the 300 pN at low temperatures.

Imaging DNA with AFM requires a substrate on which the DNA can be adsorbed from an aqueous solution. Under these conditions a water layer is present at the surface. Therefore, it is crucial to control this water layer when scanning a low temperature and under UHV conditions. This thin layer covering the sample can reduce the resolution and leads to the formation of a quasi-liquid layer between sample and the tip. We tried to avoid the presence of a water layer by choosing hydrophobic substrates as HOPG.

We showed the importance of different degree of hydrophobicity for achieving high resolution images at low temperature and under UHV conditions.

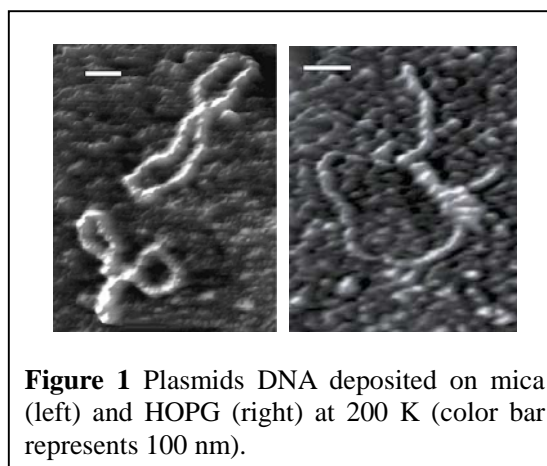


Figure 1 Plasmids DNA deposited on mica (left) and HOPG (right) at 200 K (color bar represents 100 nm).

[1] A. Radenovic et al., Rev. Sc. Instr. **74** 1022 (2003)

[2] M.F. Perutz, Nature **358** 548 (1992)

[3] J.V. Zoval et al, Anal.Chem. **68** 1585 (1996)