

# Preparation and characterization of electrode surface modified with multilayers of Polyoxometalate

## Nanosurf® STM Application Note

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Electrode surfaces modified with polyoxometalates have gained much interest in recent years, among others because of their electrocatalytic properties. The functionalization of different electrode surfaces with these inorganic clusters has been reported by several authors [1].

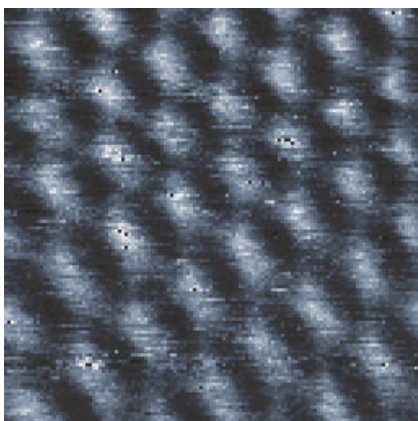


Figure A 11nm x 11nm STM image of the crystallite;  $V_{tip}=50mV$   $I_{tip}=0.98nA$

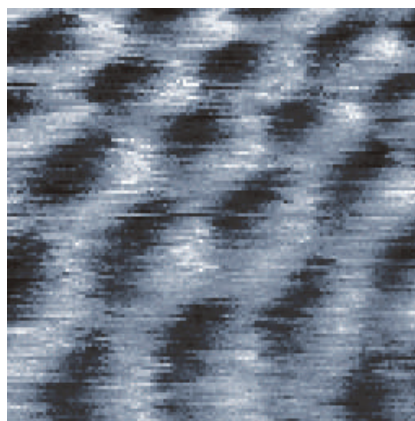


Figure B 8nm x 8nm STM image of the multilayer;  $V_{tip}=492mV$   $I_{tip}=0.96nA$

The characterization of the surfaces with analytical tools like Scanning Tunneling Microscopy is, so far, restricted to monolayers of these anions [2].

We have generalized a modification scheme which allows us to tailor the properties of the solid/electrolyte interface by alternate absorption of polyoxometalate anions and selected cations [3,4]. The so-obtained Ionic Self Assembled Multilayers (ISAM) show interesting redox properties and can be examined with the above mentioned technique.

Figure A illustrates the surface structure of a  $H_x(NH_4)_{12-x}P_2Mo_{18}O_{62}$  microcrystallite attached to a HOPG surface. Visualization becomes possible because the polyoxometalate is in its reduced form and therefore electronically conductive. Figure B shows the surface of a multilayer consisting of three anionic  $P_2Mo_{18}O_{62}^{6-}$  layers and two intercalated cationic layers of methylviologen, obtained by our simple dipping procedure. Both images were obtained in air, in the constant height mode and are unfiltered.

[1] M.Sadakane, E.Steckhan, Chem.Rev. 98 (1998) 219

[2] W.G.Klemperer, C.G.Wall, Chem.Rev. 98 (1998) 297

[3] A.Kuhn, F.C.Anon, Langmuir 12 (1996) 5481

[4] A.Kuhn, N.Mano, C.Vidal (1998) submitted