Simultaneous non-contact amplitude modulation and electrostatic force microscopy for studies of water interaction with organic molecules.

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The interaction of water with self-assembled monolayers of alkylsilanes on mica substrates has been studied using a combination of electrostatic and non-contact dynamic AFM technique. This operation mode proves to be minimally invasive, stable and capable of high resolution imaging for studies of topographic and electrical properties of metals and dielectric materials. The technique is based on the simultaneous electrical and mechanical modulation of a conductive cantilever. Two feedback loops adjust the tip sample distance and the dc bias applied to the tip to maintain constant the oscillation amplitude and the contact potential through the image. The four images acquired simultaneously (topography, phase, dielectric constant and contact potential) contain the same information as that provided by other well established non-contact techniques: Scanning Polarization Force Microscopy[1], Kelvin Force Microscopy[2] and non-contact Amplitude Modulation Force Microscopy[3],[4]. We demonstrate the usefulness of the technique by studying the interaction of water with self-assembled monolayer islands of alkylsilanes, a problem of considerable interest in the MEMS technology, where water vapour is known to affect the mechanical properties of friction, and anti-stiction of the silane protective coatings.

Fig. 1 shows four images taken simultaneously of at 40% relative humidity. They correspond to topography (1a), phase (1b), contact potential (1c) and dielectric constant (1d). The results show that the islands are effective in blocking the penetration of water. The results also show how the simultaneous and independent collection of complementary data highly can improve data interpretation.

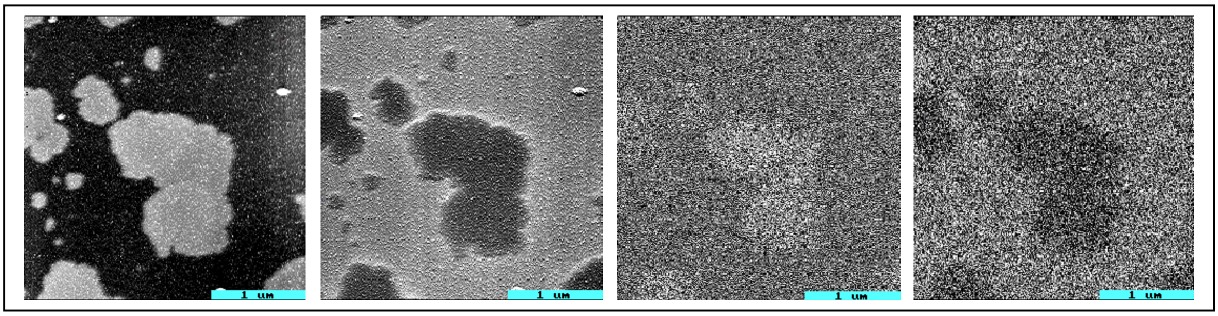

Fig 1a. Fig. 1b Fig. 1c Fig. 1d

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