# application note

Lise-Meitner-Straße 6, D-89081 Ulm, Germany
Tel. +49 (0) 731 140 700, Fax. +49 (0) 731 140 70200
www.witec.de, info@witec.de

## Digital Pulsed Force Mode – Thin Layers of Polyvinylalcohol

For many technical applications, achieving a deeper understanding of the surface structures of thin polymer films on various substrates is an important goal. Depending on the specific interaction between polymer and substrate, structures in the micro and nanometer regime are observed instead of a uniform layer. The formation of the structures occurs due to dewetting and segregation processes. Offering easy sample preparation and resolution in the far sub micron range, Atomic Force Microscopy (AFM)is a technique which is perfectly suited to the needs of these studies. In many cases not only the topography, but also material properties of the surface are of great interest. The Digital Pulsed Force Mode provides a convenient way to perform such measurements.

The result of such an investigation is shown below. A polyvinylalcohol-water solution was applied on mica. After the evaporation of the water, the polymer film was observed with the WITec alpha300 A System under control of the Digital Pulsed Force Mode.

Fig. 1 shows the topography of the polyvinylalcohol film. One can see three different phases with layer thicknesses up to 9 nm.

An interesting investigation is the local stiffness of the polymer in the different phases. Due to the thin layer-structures, only low forces should be applied, to ensure that substrate properties are not measured. Therefore, the interpretation of single force curves is delicate. With the Digital Pulsed Force Mode investigation of force curves becomes possible in a way previously unknown. Analysing thousands of curves and using linear regression, the signal/noise ratio can be increased in a way that makes possible imaging of local stiffnes properties of very thin layers. Fig. 2 shows a map of the local stiffness of the sample (brighter colours are representing higher values).

Additional information can be obtained by acquiring the adhesion, which is shown in Fig. 3 (brighter colours are representing higher values). The islands show lower adhesion than the other two phases.

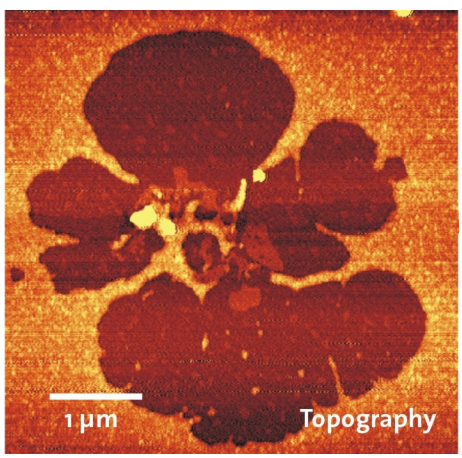


**Fig. 1:** Topography

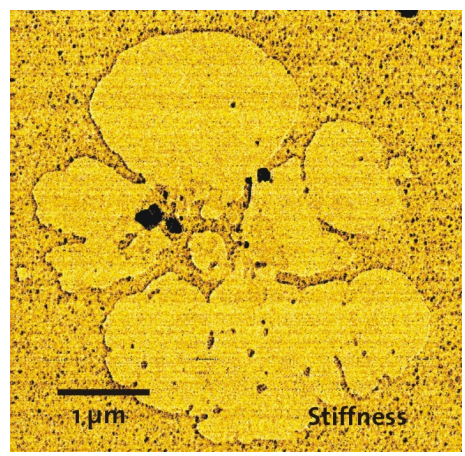


**Fig. 2:** Stiffness

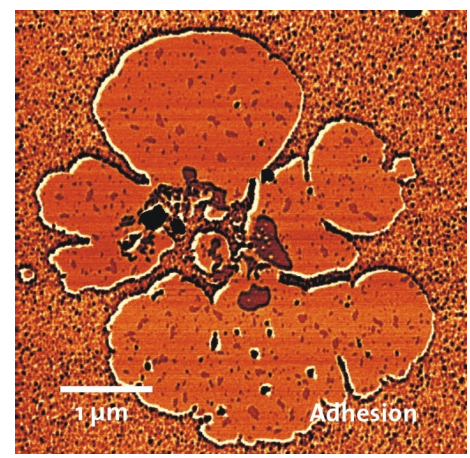


**Fig. 3:** Adhesion

Samples courtesy of G. Haugstad,
University of Minnesota, Minneapolis, USA