

Gold-P3OT contact studied by Kelvin probe microscopy

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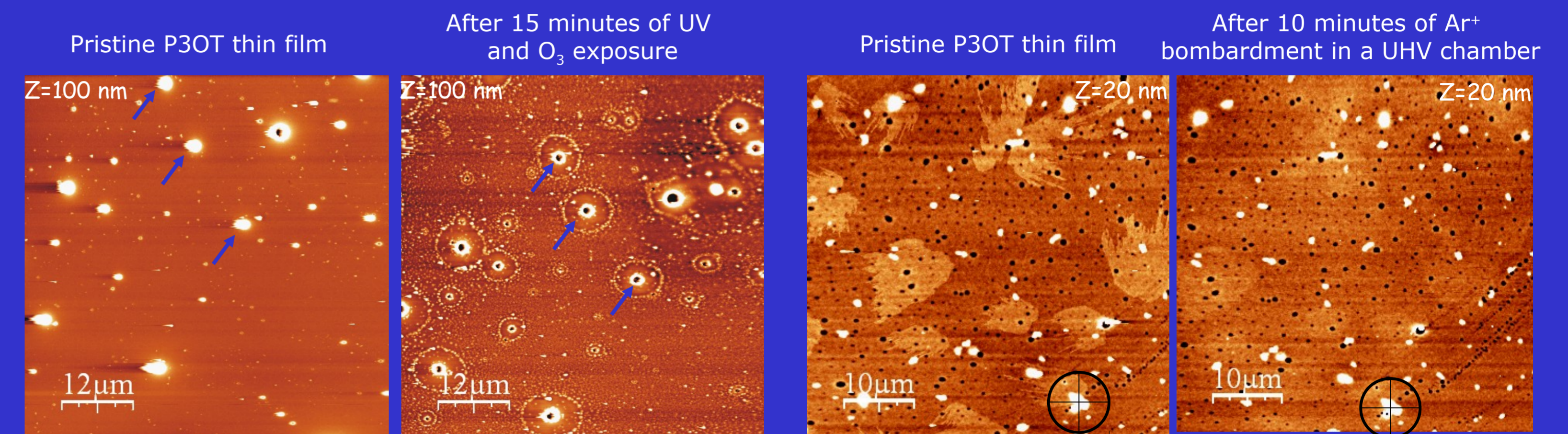
Introduction

Poly-(3-octylthiophene) is one of the most promising materials for applications in organic opto-electronic devices such as field-effect transistors, light-emitting diodes and in particular plastic solar cells. In the field of organic solar cells a complete understanding of the metal-polymer interface is of vital importance in order to make this technology competitive with traditional silicon solar cells. In the present work we investigate the interaction between P3OT thin films and Au.

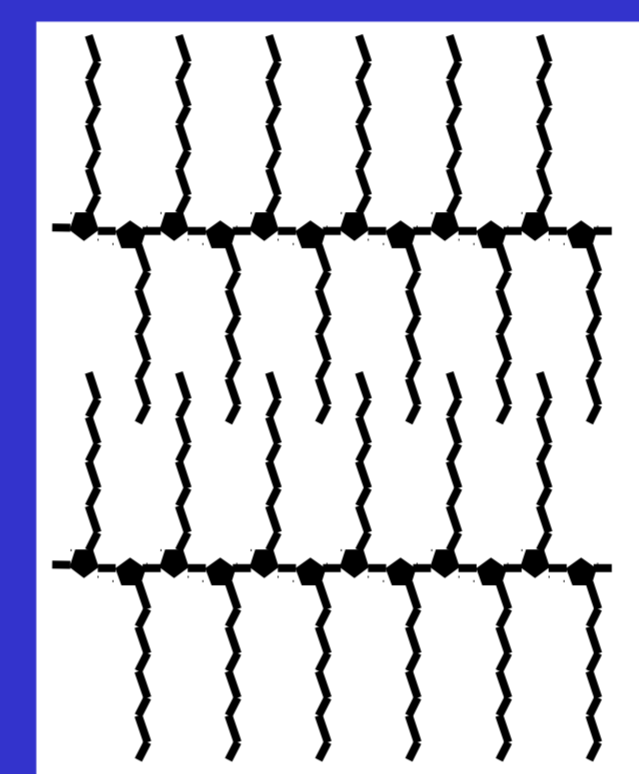
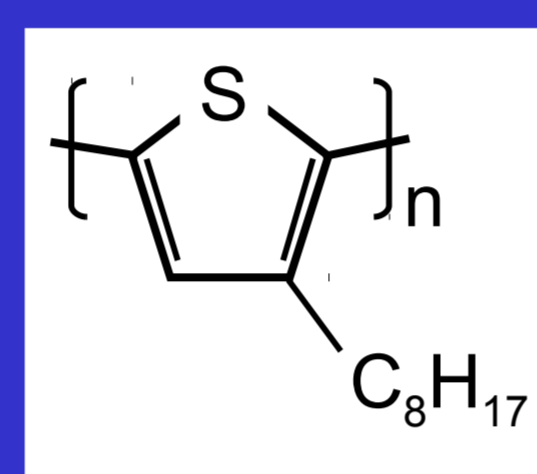
We have evaporated Au on to P3OT films of about 100 nm thickness. The samples were characterized by different non-contact Scanning Force Microscopy (SFM) techniques, in particular **Kelvin Probe Microscopy**. Our experimental setup allows us to perform SFM studies of the same area even if the sample is taken out of the SFM system for different processes (Au evaporation). This allows a detailed knowledge about the effect of adsorbed metal particles on the morphology and electrical properties of polymer thin films at the nanoscale. Our results can contribute to explain what happens in the metal-polymer interface of the devices, when the metal contacts are growth. Thereby the observed nanoscale structural changes can be correlated with the overall performance of the fabricated devices.

Experimental: Precise re-allocation

We have developed a new micron-precision sample holder integrated in the Nanotec AFM system
Two examples: ex-situ analysis of the same sample region
- Ultraviolet and ozone degradation of P3OT thin films
- Ar ion bombardment under UHV conditions of P3OT thin films



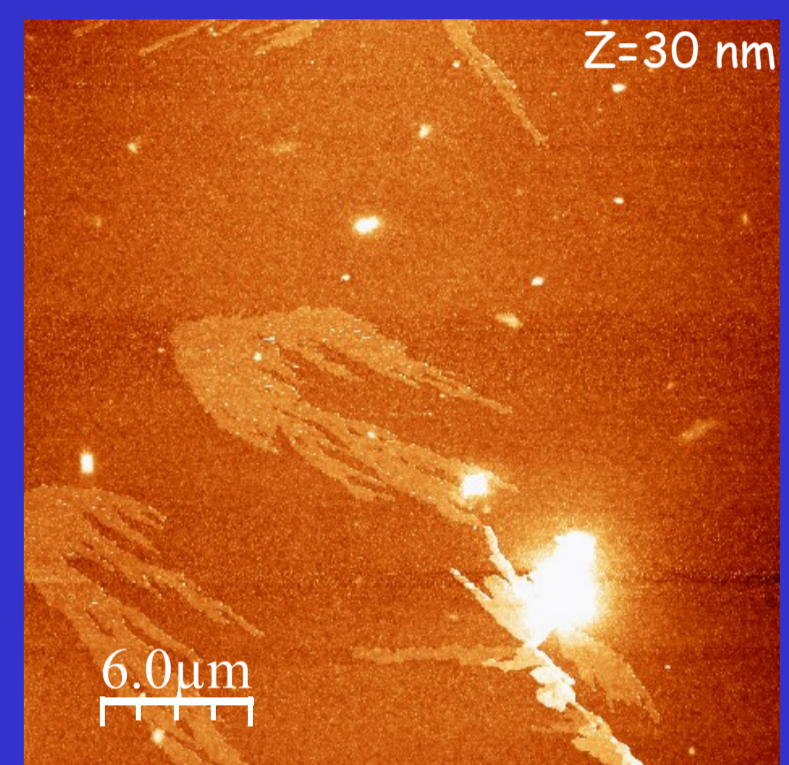
P3OT



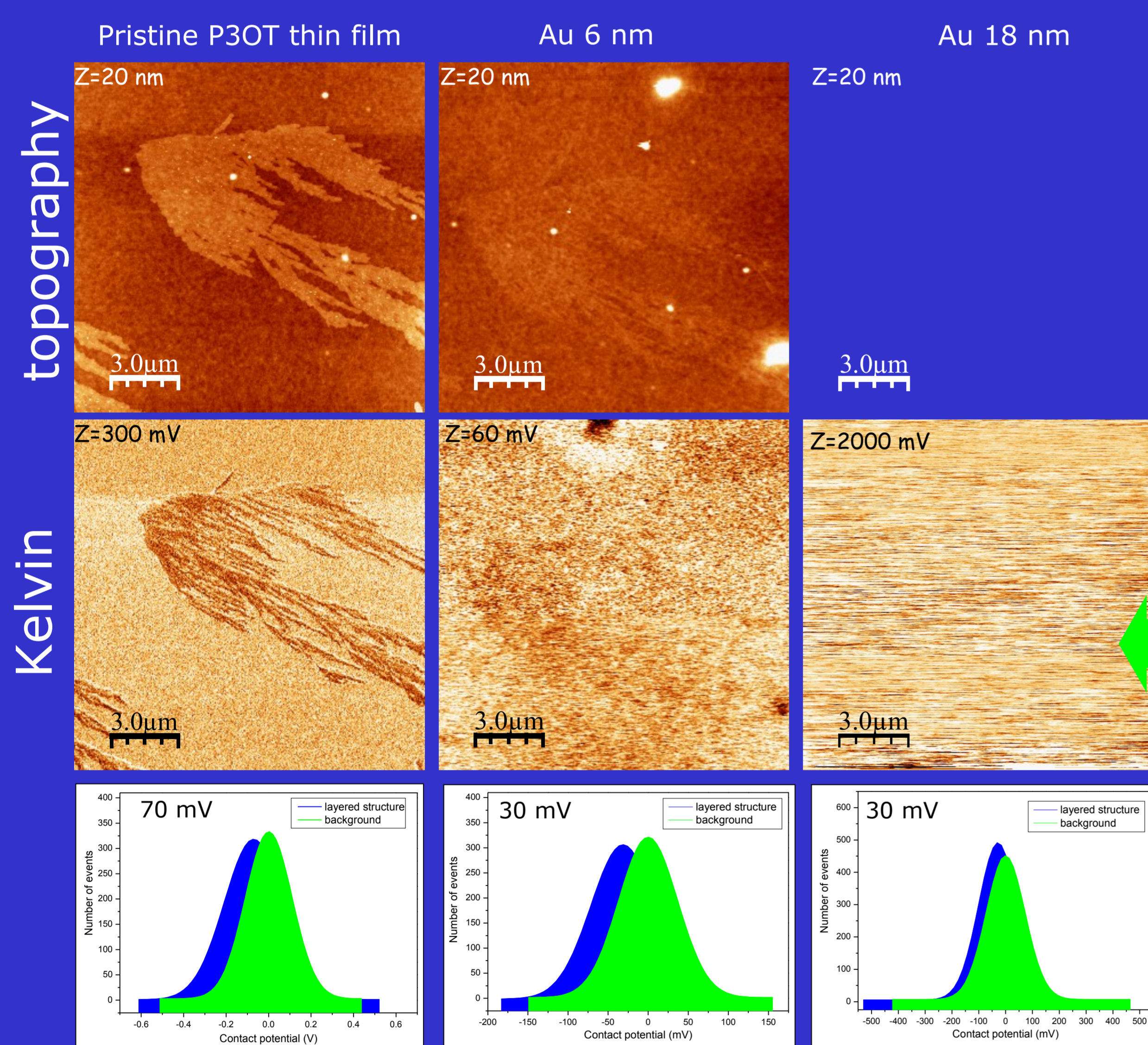
The samples

Pristine P3OT thin films
20 mg/ml solution of P3OT in Toluene
Spin cast at 2500-4000 rpm
Substrate gold thin film

Gold evaporation in a vacuum chamber
 $P < 1 \times 10^{-4}$ mbar
Thickness 6 nm and 18 nm

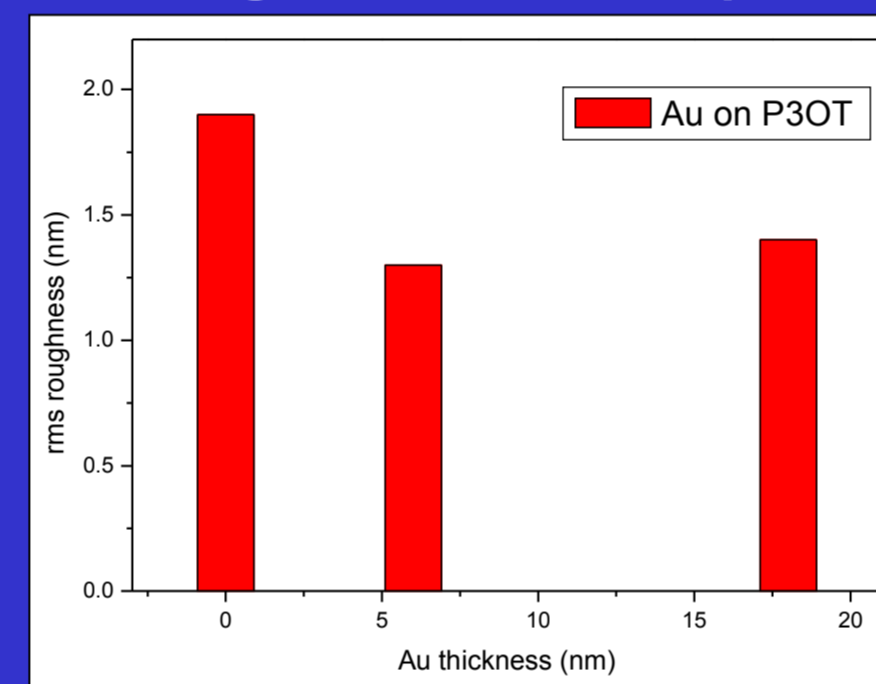


Topography and Kelvin results

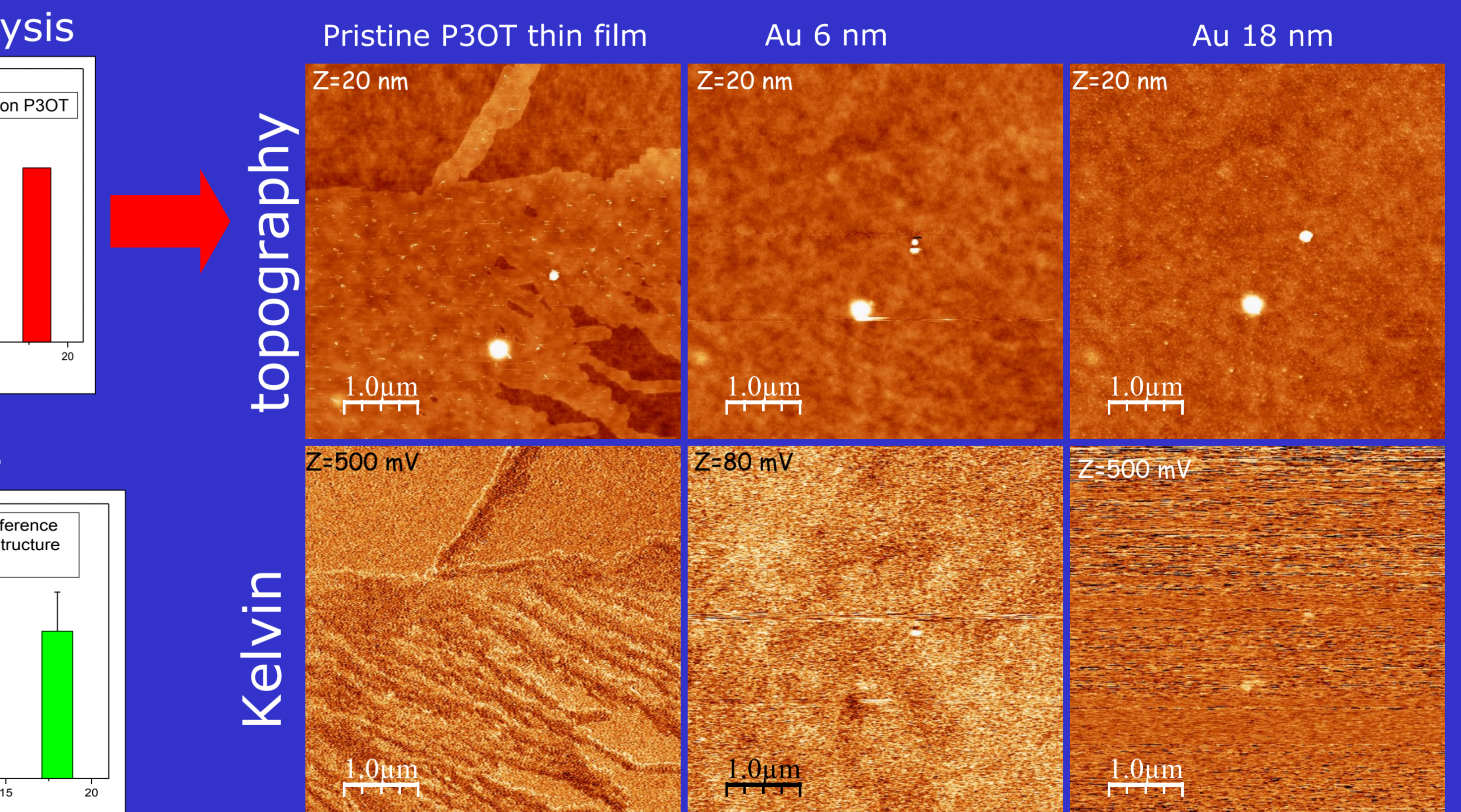
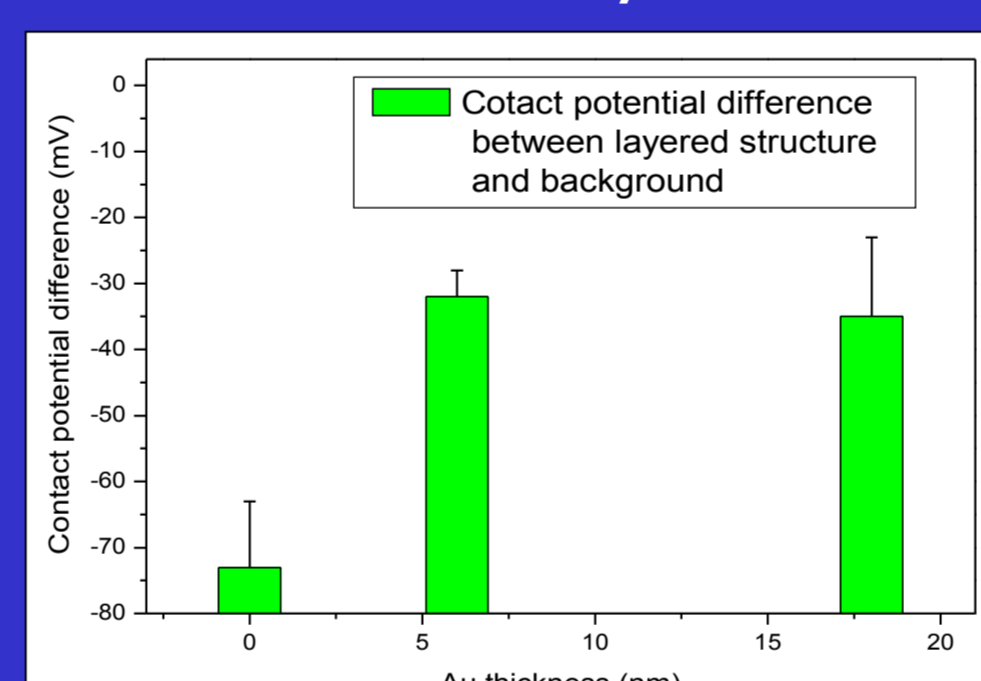


Kelvin: Contact potential images shows that a homogeneous conducting thin Au film is not immediately formed. Some contact potential contrast of the layered structures are still visible underneath the Au film.

Roughness analysis



Kelvin analysis

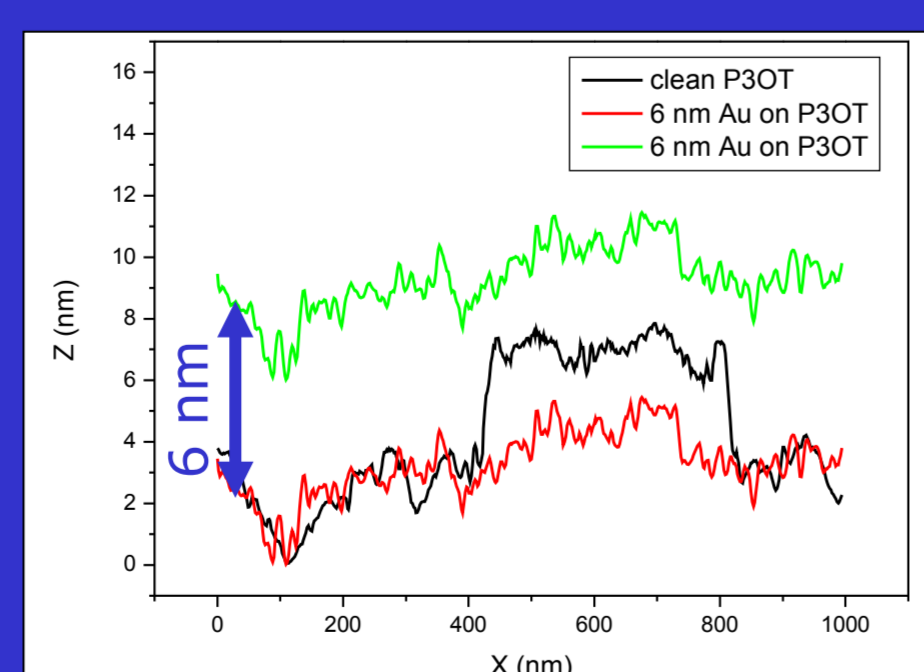


Topography: Au deposition decrease the surface roughness. However, some features of the layered structures are still visible after 18 nm of Au evaporation

Au seem to diffuse into polymer chains, great affinity between Au and S in the thiophene ring, in this process the layered structures are "dissolved"

The interface between Au and P3OT is not sharp.

Topography high resolution images: After the Au evaporation the topography contrast is not maintained: layered structure decrease from 4.1 nm to 1.5 nm



Kelvin high resolution images: Contact potential domains of the clean P3OT film are lost after the Au evaporation, however contact potential contrast is still visible

