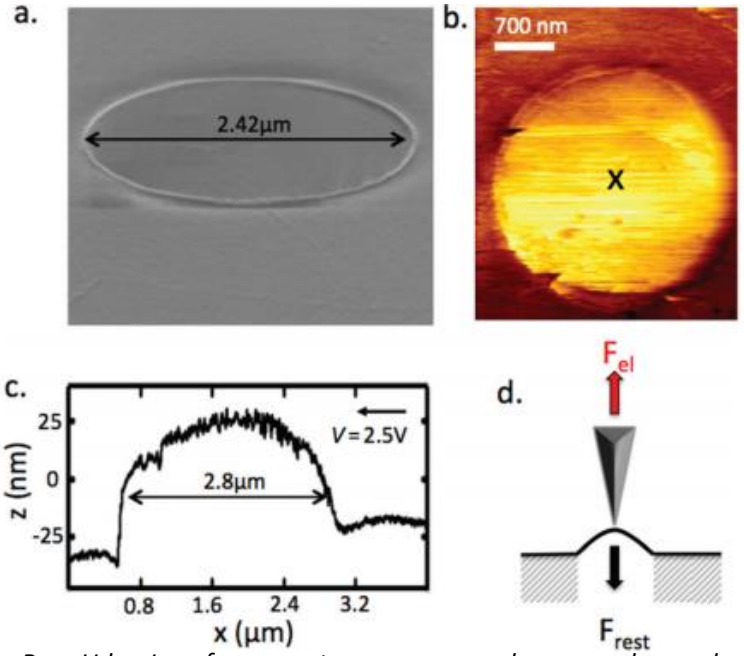
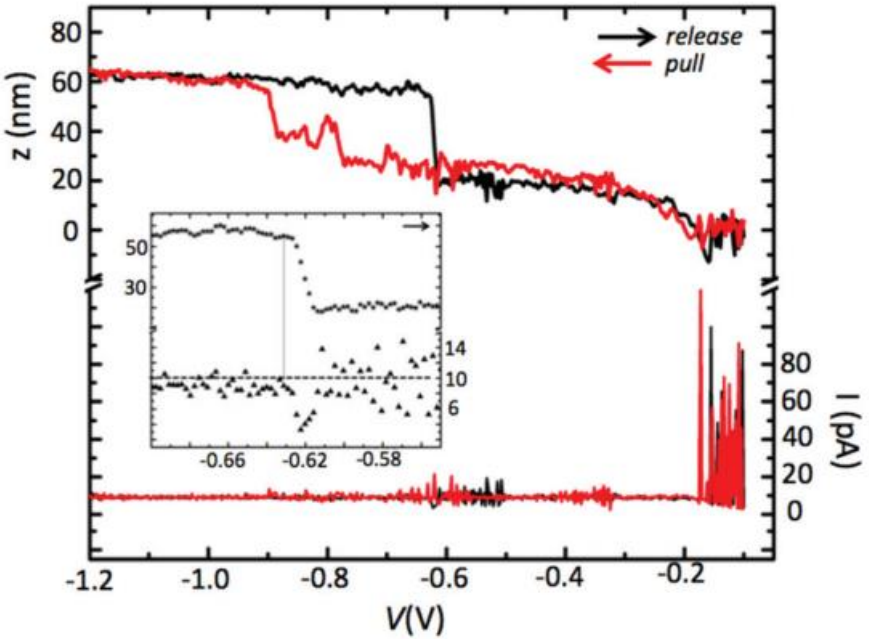
Low-force spectroscopy on graphene membranes by scanning tunneling microscopy†

Main objective: show a technique which utilizes a tip in tunneling contact at low currents and with tip– sample forces below 1 nN to realize a bulge-test scenario, to control the strain and to measure simultaneously the membrane deflection at sub-nanometer resolution.

About the samples: Samples were mounted ex situ and subsequently introduced into the Ultra High Vacuum (UHV) system. Imaging was performed without further sample treatment in UHV.



Methodology: Force spectroscopy was realized by recording the vertical tip position (z) in tunneling contact as a function of the applied sample bias (V) with active feedback. The tunneling current (I) was typically set to 10 pA. This corresponds to a tunneling distance of z0 = 1.2 nm at V = 0.1 V as obtained by z(I) experiments on HOPG.



We have shown that the subtle interaction between a tip and an atomically thin graphene membrane in tunneling contact can be used for non-indenting force spectroscopy. Quasi-static force spectroscopy is achieved by applying a slow sample bias ramp at a low tunneling current to deflect the membrane and to simultaneously monitor the deflection by STM.

Referece: Bern Uder, Low-force spectroscopy on graphene membranes by scanning tunneling microscopy, Nanoscale, 2018.