

# 1 Abstract

This thesis presents a new method to explore the local mechanical properties such as bending modulus or surface tension of artificial and native pore-spanning membranes. Therefore the elastic response of a free-standing membrane to a local indentation by the means of atomic force microscopy is measured.

Starting point are highly hexagonal ordered pores in alumina produced by electrochemical anodization of planar aluminium. The homogeneous pore radius can be tailored in the range of 10 nm up to 200 nm, but radius of 33 nm, 90 nm and 200 nm turned out to be best suited for investigation of the mechanical properties of pore-spanning native or artificial membranes.

In this work artificial membrane systems consisting of DODAB as a bilayer in gel phase or DOTAP chloride as a fluidic membrane are spreaded by vesicle absorption on hexagonal structured pores after chemisorption of a 3-mercaptopropionic acid monolayer. Centrally indenting these *nanodrums* with an atomic force microscope tip yields force-indentation curves, which are quantitatively analyzed by solving the corresponding shape equations of continuum curvature elasticity. Since the measured response depends in a known way on the system geometry (pore size, tip radius) and on material parameters (bending modulus, lateral tension, adhesion), this opens the possibility to monitor local elastic properties of lipid membranes in a well-controlled setting.

Additionally the locally distributed mechanical properties of pore-spanning artificial membranes are compared to those of native pore-spanning membranes. Therefore the basal membrane of MDCK II cells was prepared on porous alumina assays and their mechanical properties were analyzed by means of atomic force microscopy.

Finally the elastic behavior such as the *Young* modulus of living MDCK II cells under various osmotic pressures is investigated. By changing the osmolarity in the extracellular region of MDCK II cells a volume change is induced according to hydration and dehydration of the cells, respectively. This volume change induces also a change in the elastic behavior of the cell, which is quantified by the means of force spectroscopy.