

P11 – Protrusion Force Measurements With the SFM on Motile Cells

Claudia Brunner, Michael Gögler, Daniel Koch, Allen Ehrlicher,
Thomas Fuhs and Josef Käs
University of Leipzig; Exp I/ Soft Matter Physics;
Linnéstrasse 5; 04103 Leipzig; cbrun@physik.uni-leipzig.de

A fundamental step in cell migration is the advancement of the cell's leading edge. It is generally accepted that this motion is driven by actin polymerization against the plasma membrane but this has not been directly measured.

Here we present precise force measurements using a newly established SFM-technique combined with high resolution imaging and lamellipodium feature tracking analysis. Our AFM-based technique uses the vertical and lateral deflection of a modified cantilever and allows direct measurements of the forces exerted by the cell. Interference reflection microscopy allows us to observe the cell during locomotion beyond the cantilever. We measure the maximum forces which are generated at the leading edge of the lamellipodium, retrograde forces within the lamellipodium, and the cell body. Through selective manipulation of molecular components by addition of different drugs, such as Jasplakinolide, Cytochalasin D, and ML-7 the measured forces and velocity changes can be compared. Our studies provide a unique dynamic force map giving the magnitude and direction of the intracellular forces in fish keratocytes and reveal the molecular origin of the forces.

We resolve that the force generating mechanism at the leading edge is indeed actin polymerization, and we directly measured a force attributed to the retrograde flow within the lamella, which critically demonstrates that the protrusion forces are decoupled from the cell body and are generated exclusively at the leading edge.

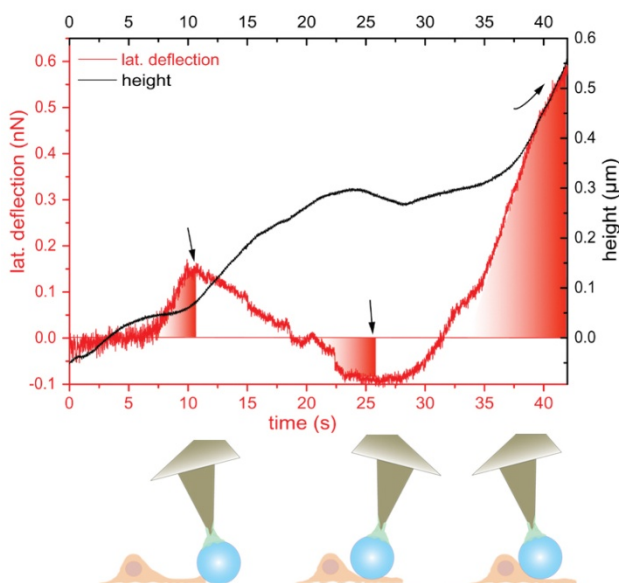


Fig.1 SFM-measurement of a migrating cell. The lateral deflection (red) reflects the forces the cell is pushing the cantilever, while moving beyond it (black line: height signal). Sketch of the experiment shown below.

