Advances in AFM force measurements at high-speed

Felix Rico

Aix-Marseille Université, CNRS, INSERM, France

Courriel : felix.rico@inserm.fr

High-speed atomic force microscopy (HS-AFM) is a unique technology allowing sub-second, nanometric imaging of biological samples [1]. We have adapted HS-AFM to perform high-speed force spectroscopy (HS-FS) both on single molecules and living cells with microsecond time resolution. In this talk, I will describe the characteristics of HS-AFM and will show applications to probe biomolecular interactions and living cells [2-6]. HS-FS opens an avenue to better understand the mechanics of proteins and cells at previously inaccessible short timescales, and to address long standing and emerging questions.

References:

1. T. Ando, N. Kodera, E. Takai, D. Maruyama, K. Saito, and A. Toda, "A high-speed atomic force microscope for studying biological macromolecules," Proceedings of the National Academy of Sciences **98**, 12468–12472 (2001).
2. F. Rico, L. Gonzalez, I. Casuso, M. Puig-Vidal, and S. Scheuring, "High-Speed Force Spectroscopy Unfolds Titin at the Velocity of Molecular Dynamics Simulations," Science **342**, 741–743 (2013).
3. H. Takahashi, F. Rico, C. Chipot, and S. Scheuring, "α-Helix Unwinding as Force Buffer in Spectrins," ACS Nano **12**, 2719–2727 (2018).
4. F. Rico, A. Russek, L. González, H. Grubmüller, and S. Scheuring, "Heterogeneous and rate-dependent streptavidin–biotin unbinding revealed by high-speed force spectroscopy and atomistic simulations," PNAS **116**, 6594–6601 (2019).
5. C. Valotteau, F. Sumbul, and F. Rico, "High-speed force spectroscopy: microsecond force measurements using ultrashort cantilevers," Biophys Rev (2019).
6. A. Rigato, A. Miyagi, S. Scheuring, and F. Rico, "High-frequency microrheology reveals cytoskeleton dynamics in living cells," Nat Phys **13**, 771–775 (2017).