# ForceRobot®

## The New Era of Force Spectroscopy.

### Automated Force Spectroscopy

- Folding/Unfolding Dynamics
- Binding Site Localization
- Inter- & Intramolecular Interactions

JPK Instruments

*Nanotechnology for Life Science*

# Where Nanotechnology Meets Molecular Analytics.
# ForceRobot® – the Automated Force Spectroscope.

### Automated force spectroscopy – A revolution in molecular analysis

Force spectroscopy is a single molecule technique that allows the real-time study of molecular interactions on the nanoscale. Originating from the broad field of Atomic Force Microscopy (AFM), force spectroscopy provides the necessary sensitivity to characterize biomolecular interactions such as the unfolding forces of single proteins or forces of a single chemical bond.

### Force spectroscopy technique

Force spectroscopy is the method of choice whenever scientists want to understand how individual biomolecules, small compounds, polymers and surfaces interact with each other. No averaging, labeling or indirect conclusions, but clear-cut results with forces and distances, delivered in absolute numbers.

### A label-free single molecule technique

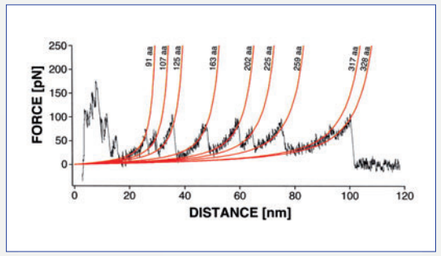
Force spectroscopy provides information on molecular properties without the need for chemical labeling. This information is relevant for the study of:

**Intermolecular interaction examples**

- Characterization of receptor-ligand, antibody-antigen, or DNA/aptamer-protein interactions in biophysics, biochemistry and molecular cell biology
- Molecular adhesion studies in surface chemistry and polymer science

**Intramolecular interaction examples**

- DNA melting, polymer stretching, protein unfolding, and polysaccharide elasticity in molecular medicine, pharmacology, bionics and food technology




*Force spectroscopy curve: Unfolding of a single $H^+/Na^+$ antiporter NhaA from E. coli. Courtesy of A. Kedrov, D.J. Müller, Technical University Dresden, Germany*

### Force spectroscopy applications

- Localization of binding and stoichiometry of small molecules on proteins (e.g. inhibitors on membrane proteins)
- Analysis of protein (un)folding and function
- Quantification of kinetics, affinity and energy landscapes of biological interactions
- Analysis of adhesion strengths of single macromolecules

### Our know-how drives your success

For the very first time, the automation of force spectroscopy makes it fast enough to deliver high quality data in short time-frames. The experienced user will appreciate the improved data quality and excellent routine performance. The beginner will enjoy how easily accessible this nanotechnology has become.

JPK provides the tools and the expertise to advance your force spectroscopy experiments. Through close cooperation with scientific pioneers in this field, JPK has made force spectroscopy available to a broad range of scientists.

### What makes the difference?

Until now, force spectroscopy was a complicated procedure. The requirement of frequent manual calibrations and alignments as well as the need for permanent instrument attention made it a cumbersome task. Additionally, useful data output was very low. Only a few force curves were collected manually over many hours. To make use of the full potential force spectroscopy offers, you need a dedicated tool.
The ForceRobot® is built to perfectly address all the demands of a force spectroscopy experiment.

### Faster time-to-results

The basis for a meaningful interpretation of a force spectroscopy experiment is based on a large number of reproducible data sets. Using the ForceRobot® overcomes the limitations of traditional force measurements. The ForceRobot® automates routine procedures and provides software support for experimental design, data acquisition and evaluation.

### Perfect environmental control

The mechanical properties of single molecules are strongly influenced by their environment. The unique environmental control of ForceRobot® is tailored to this requirement. The full temperature control of the measurement chamber allows the study of biological samples at physiologically relevant temperatures. The integrated fluidic system allows the design and performance of experiments with different buffer composition, pH value or chemical agents. The stability of the measurements is ensured by integrated vibration and acoustics isolation.

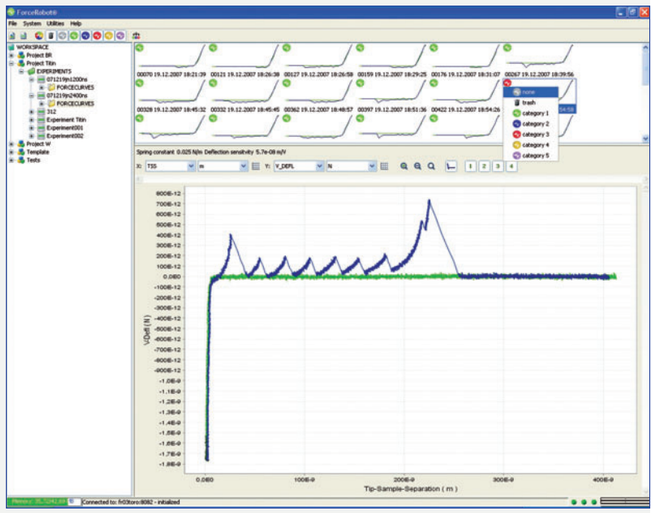
*ForceRobot® sample holder*

### Higher quality of force spectroscopy data

The quality of the force spectroscopy data is the key to successful analysis and interpretation. In this context the lowest electronic noise floor and the most rigid mechanical design are essential.
Tens of thousands of force curves are generated in a matter of hours in unattended mode. Force curves without events are automatically filtered out and the useful data are presented for further evaluation.

### State of the art software

The ForceRobot® software package is characterized by its completely automated data acquisition. This comes with an intuitive user interface – a new way to structure the data analysis, intelligent user defined classification and fitting algorithms that standardize the usual 'manual' procedures.




*Screenshot of the force curve browser*

### Auto calibration

The ambiguity of classic calibration procedures is removed by a standardized, fully automated spring constant and deflection sensitivity calibration. Precision temperature sensors ensure the most accurate thermal noise cantilever calibration. Continuous auto-calibration and a rigorous drift-free mechanical design enable long term measurements with consistent data quality.

# ForceRobot®
# Technical Specifications

## Head
- Rigid low-noise design and drift-minimized mechanics mounted on an integrated vibration isolated platform
- Liquid-safe design and easily accessible sample port
- IR detection light source with low coherence for interference-free measurements
- > 80,000 curves per 24 hours in unattended mode while varying parameters such as temperature or loading rate
- XYZ-sensor noise level: 0.1 nm RMS at 0.1-1 kHz bandwidth (0.2 nm RMS at 0.1-10 kHz bandwidth)
- Three-axis closed loop and high-speed flexure stage with ultrafast z-response
- 4 x 4 x 4 µm³ piezo positioning range
- Travel range of motorized sample stage: 2 x 2 mm²
- Intelligent and automated approach
- Automated laser and detector alignment

## Sample holder
- Ready-to-use for contamination-free sample insertion
- Small volume design saves expensive sample material
- Fluid chamber with optimized flow reduces dead volumes and prevents cross-contamination
- Compatible with a wide range of cantilevers, including Olympus® BioLever
- Disposable plastic or chemically resistant glass fluid chamber

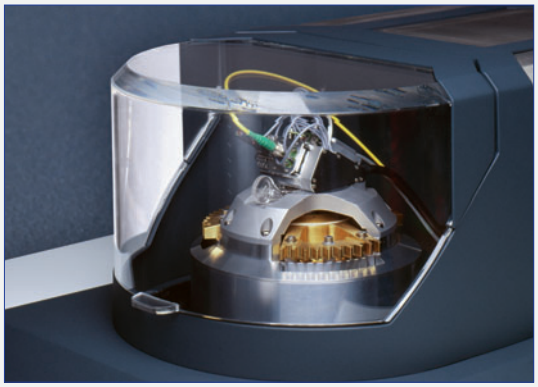
## Fluid handling
- Closed system for safe and easy fluid handling
- Software-controlled flow rate
- Integrated leakage-free tube connectors for fluid exchange
- Automated incubation or adding of chemicals
- Comprehensive safety package

## Electronics
- High-speed data capture
- Modular analog and digital design with latest FPGA/DSP technology
- Discrete analog high-speed high voltage amplifiers
- Gigabit Ethernet interface for fast data link

## Temperature control module
- 4-80°C temperature range with 0.1°C precision
- Thermoelectric temperature control setup

## Software
- Java™ application running on Microsoft® Windows®
- Fully automated data acquisition
- Automated re-calibration and drift compensation
- Fully automated sensitivity and spring constant calibration
- Built-in cantilever geometry database for automatic alignment
- Up to 1.2 million data points per force curve
- Standardized basic as well as user-defined measurement procedures
- Advanced spectroscopy modes such as force clamp or user-defined ramp definition, e.g. for temperature or pulling speed
- User-defined measurement and analysis procedures using graphical 'planner' interface
- Automatic classification of force curves
- Automated filtering of curves without events with software-based selection
- Remote operation through internet connection

## Dimensions
- Width x Height x Depth = approx. 76 x 131 x 101 cm³
- Weight = approx. 270 kg



*ForceRobot® head*



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