Precise magnetic tweezers for reliable pico-Newton force measurements on biological molecules

Technology #cu15168

Magnetic tweezers enable investigation of the molecular-scale forces in individual biological molecules, such as ligand binding to proteins. These molecules are generally around one nanometer in size, thus precise measurements of these forces remains a major research challenge because of mechanical drift on such small scales. This technology is a design for magnetic tweezers that uses a voice coil mechanism to increase their speed, accuracy, and stability. This both lowers the cost of conducting experiments on single biomolecules and makes the magnetic tweezers a viable tool for high-throughput screening.

Magentic tweezers can apply constant, pico-Newton forces to biomolecules over several hours

The magnetic tweezers described by this technology use the HaloTag method to attach a molecule (protein or DNA) to the glass surface of a fluid chamber and the AviTag method to bind a magnetic streptavidin-coated bead to the free end of a protein or DNA molecule. The voice coil controls a magnet positioned above the fluid chamber with sub-micrometer resolution at speeds of ~0.7 m/s over a 1 cm range. Forces on the pico-Newton (pN) scale can be held constant over several hours without mechanical drift, allowing the tweezers to make high resolution force measurements.

This technology has been used to measure the folding kinetics of protein L at forces as low as 10-15 pN.

Lead Inventor:
Julio M. Fernandez, Ph.D.

Applications:
• Research tool for investigating molecular-scale forces on individual biomolecules
• High-throughput screening tool for studying protein-ligand binding
• Research tool for measuring protein-DNA binding interactions
• Measurements of protein folding kinetics
Advantages:

• Measurements are accurate and high resolution
• Can be controlled with high speed and precision
• pN scale forces can be held constant without mechanical drift
• Can be combined with other technologies such as total internal reflection microscopy and evanescent nanometry

Patent Information:

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Related Publications:


Inventors

Julio M. Fernandez