

Studying the motor protein kinesin with high-speed atomic force microscopy

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Motor proteins are proteins that can perform a directed motion typically by utilizing some kind pathway in order to transport cargo or generate motion and forces on the cellular level. In this presentation, the focus will be on the motor protein kinesin moving along microtubules using high-speed atomic force microscopy (HS-AFM).

Kinesin is utilizing adenosine triphosphate (ATP) to walk in a step-by-step fashion on microtubules and is responsible for intracellular transport and also plays a crucial role in mitosis. Microtubules, which are protein tubes made from tubulin with a diameter of 25 nm and potentially tens of micrometers long, were also believed to be a mechanosensor in combination with kinesin, allowing them to respond to external forces a cell is subjected to. While there was evidence from single-protein fluorescence studies, the mechanisms proved elusive. With the help of HS-AFM, it was possible to record nanometer resolution videos of kinesin moving on microtubules. It was found that bending the microtubules caused the kinesin to slow down considerable compared to straight microtubules. Further, it was concluded that either stretching or compressing the bond between two tubulin dimers increases the bonding energy between kinesin and tubulin. This causes the kinesin motors to adhere stronger to the microtubule and effectively slow down their movement.

In the end, a brief outlook will be given on ongoing developments to extending the functionality of HS-AFM.