

Structural dynamics of acto-myosin V revealed by high-speed AFM

Noriyuki Kodera¹, Daisuke Yamamoto^{1,2} & Toshio Ando^{1,2}

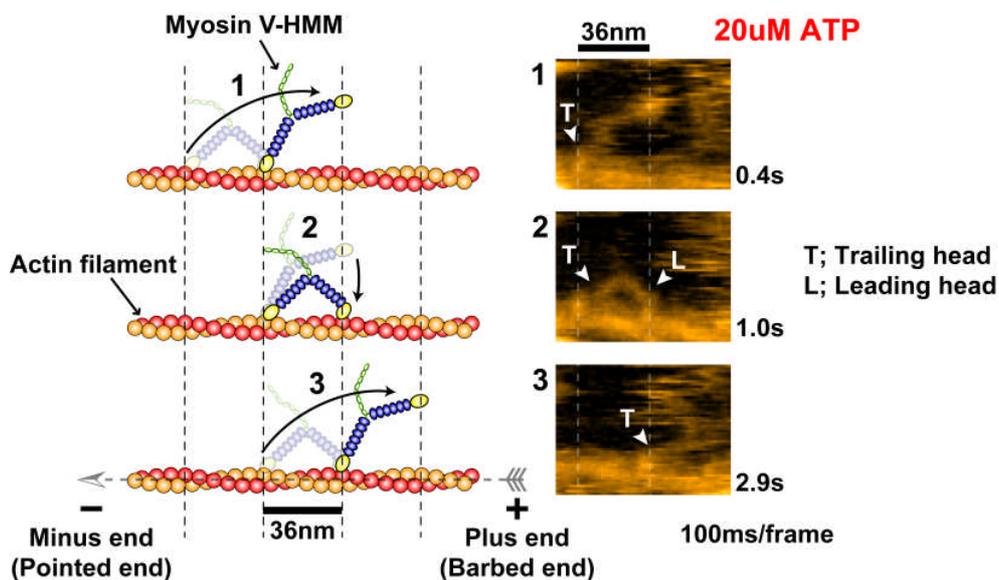
¹Department of Physics, Kanazawa University, Kakuma-machi, Kanazawa 920-1192, Japan

²JST/CREST, 4-1-8 Honcho, Kawaguchi, Saitama 332-0012, Japan

E-mail: ikouyo@kenroku.kanazawa-u.ac.jp

Myosin V is a two-headed molecular motor that delivers intracellular cargos over a long distance by moving processively along actin filaments. Its chemical kinetics and mechanical properties have been elucidated in a series of biochemical and biophysical studies. The hand-over-hand model that explains the myosin V processivity has reached a consensus¹. However, its structural dynamics details during the movement has not yet elucidated by any techniques. Thus, we tried to visualize them using an advanced high-speed atomic force microscope (AFM)² equipped with various superior controllers which could enhance the scan speed and reduce the tip-sample interaction force as much as possible.

Both in nucleotide-free and ADP-containing solutions, myosin V attached to actin filaments rigidly with only one head. The bound head formed an arrow-head-like structure, from which the polarity of the actin filament was identified. The bound head was the trailing head. By the addition of ATP, first both the heads of myosin V were bound to the same actin filament at sites spaced about 36-nm apart. Then, the trailing head was detached from the actin filament, prior to which the leading head's neck region bent, so that the trailing head quickly moved forward and was wavering like searching a next binding site on the actin filament. After wavering for a while, it landed on an actin site about 72-nm apart from the previous bound-site and thus became a new leading head. These AFM movies directly showed a series of structural changes in myosin V during the hand-over-hand movement.



1. J. R. Sellers & C. Veigel, *Curr. Opin. Cell Biol.* **18**, 68-73 (2006).
2. T. Ando, T. Uchihashi, N. Kodera, A. Miyagi, R. Nakakita, H. Yamashita & M. Sakashita, *Jpn. J. Appl. Phys.* **45**, 1897-1903 (2006).