

Measurement of Environmental Effects to Single Molecular Interaction in Dynamic Force Spectroscopy

Yuichi Hirano, Atsushi Taninaka, Osamu Takeuchi and Hidemi Shigekawa
Inst. of Appl. Phys, Univ. of Tsukuba, Tennodai 1-1-1 Tsukuba, 305-8573 JAPAN
<http://dora.bk.tsukuba.ac.jp/>

Dynamic force spectroscopy (DFS) makes it possible to investigate specific interactions between two molecules such as ligand-receptor pairs at the single-molecule level. In a DFS measurement, constantly increasing unbinding force is applied to a molecular bond, and the force required to rupture the bond is measured. By plotting the rupture force against the logarithm of the loading rate, a linear relationship is obtained and the microscopic potential barrier landscapes and the lifetimes of the bond can be derived from the relationship.

In this study, we used atomic force microscopy (AFM) technique to measure the rupture force, which enables the precise analysis of molecular interactions on the basis of DFS [1-3]. We have investigated specific interactions between streptavidin and biotin molecules in a variety of buffer solutions (with different types of ion species, pH's or ion intensities). Through those measurements, it is turned out that the potential barrier landscape of the interaction strongly depends on the types of ion species in the environmental buffer solution.

We interpreted the result that the ions in the solution sometimes crosslink the molecules and strongly affect the potential barrier, resulting in the corresponding shifts of the bond's lifetime. In addition, we discuss the dependence of binding probability and the rupture force on the relative positions of the AFM probe from the measured molecules.

References

- [1] A. Taninaka, et al., *Int. J. Mol. Sci.* **2010**, 11, 2134-2151.
- [2] A. Taninaka, et al., *Phys. Chem. Chem. Phys.* **2010**, 12, 12578-12583
- [3] O. Takeuchi, T. Miyakoshi, A. Taninaka, K. Tanaka, D. Cho, M. Fujita, S. Yasuda, S. P. Jarvis, H. Shigekawa *J. Appl. Phys.* **2006**, 100, 074315.

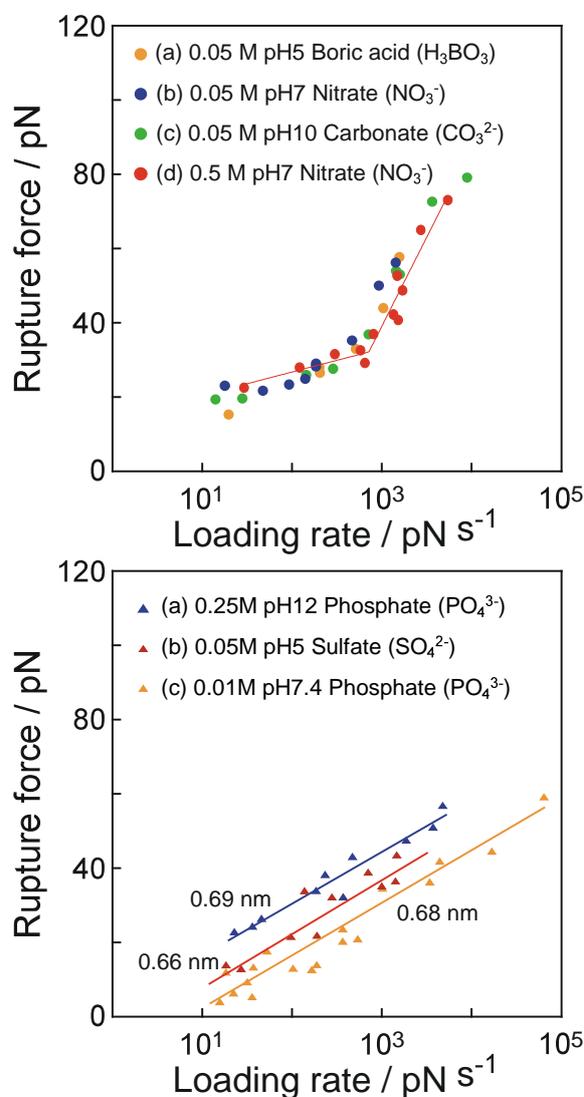


Figure 1 Information about potential barrier landscape is obtained from these lines. Two types of line represent there are two types of potential barrier condition in a same protein, but in different types of buffer.