Single-molecule Studies of the Chemo-mechanical Coupling in the Bacterial Flagellar Motor

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Many species of bacteria swim towards their favorable conditions, propelled by rotating their flagella, which extend from the cell body. Each helical flagellum turned like a screw by a tiny reversible rotary molecular motor embedded in the cytoplasmic membrane at its base. The bacterial flagellar motor consists of a rotor ring of ~50 nm diameter and ~11 independent stator units. It couples ion flux passing through ion channels in stator units to its rotational torque. To reveal how the flagellar motor works, we measured the rotation of *Escherichia coli* flagellar motor by single-molecule detection techniques. We showed that the motor working at high load converts any type of ion flux to rotation at constant efficiency by monitoring motor speed under controlled input conditions. Then we directly measured motor torque at stall by optical tweezers. These results give the minimum number of coupling ions required for motor rotation. We also succeeded in manipulating one of the two ion binding sites in each stator unit, leading to reveal kinetic cycle of motor rotation at molecular level. In this talk, I will present our recent progress and discuss the chemo-mechanical coupling of the flagellar motor.