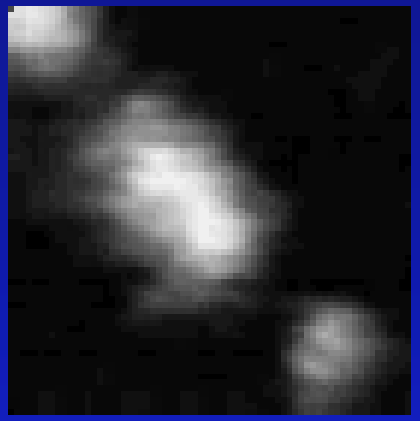
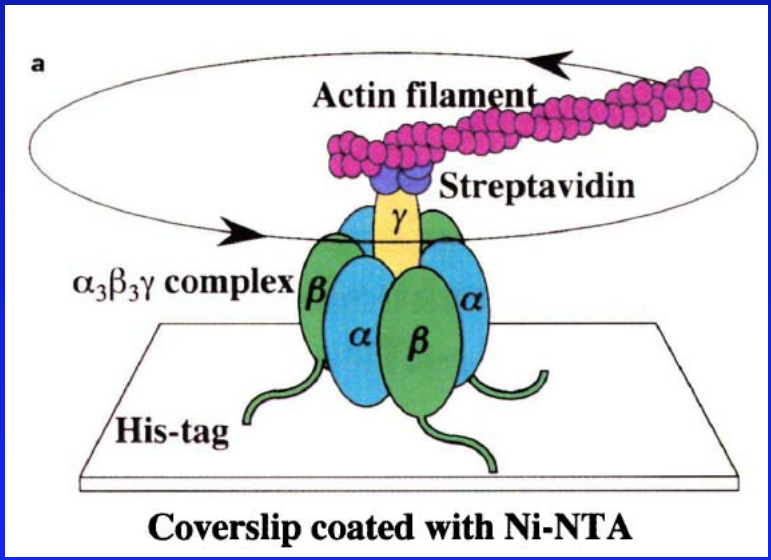
Work done by torque





(and 20 μM) ATP, the rotational rates were consistent with a constant frictional torque (the drag coefficient × the rotational rate) of ~40 pN·nm (red line in Figure 2a), indicating that the subcomplex produced this much of torque irrespective of the frictional load. This torque times 2π/3, ~80 pN·nm, is the work done in one-third of a revolution. On the other hand, the free energy of hydrolysis of one ATP, ΔG_{ATP}, is ~80 pN·nm under physiological conditions (Stryer, 1995). Thus, if one ATP is hydrolyzed per 120° revolution as implicated in the Boyer's rotational catalysis model (Boyer and Kohlbrenner, 1981; Boyer, 1997), the efficiency of the $\alpha_3\beta_3\gamma$ subcomplex is ~100%.

pN = 10^{-12} Newton

nm = 10^{-9} meter