Optical Tweezer And Cell Manipulation To Investigate Single Cell Membrane

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Goals: **Brief description**

- I will develop the model of the compact single optical trapping system.
- Physical properties of the cell membrane surface will be investigated.

Statement of Problem: Various techniques and skills have been developed in biology, not limited in traditional biology, combining other related scientific areas. Biophysics is one of those areas integrating physics to various biological phenomena. One powerful tool in Biophysics is "optical tweezer" which generates a trapping force using a gradient force by a tightly focused laser. The optical tweezer holds and manipulates small particles, which enables one to measure the exact position and the shape change of the target particle and the force of the particle interactions. The target particle should be small in the range of a few microns. Great advantages in making greater trapping force can be obtained when the target is transparent and has the large real refractive index. Therefore, biological samples such as bacteria and even single mammalian cells can be chosen as target materials for the tweezer. Due to its short history, the optical tweezer is currently on very active development. Since commercialized tweezers are still very formal and limited in functions, building the optical tweezer is valuable in that one can manipulate every single part of the optical tweezer for own purpose, especially the sample stage of the microscope. Applications of this technique are highly versatile; One can introduce liquid fluids into the trapped sample, combine it with micro- or nano-pipette, and invent various shapes of sample holders. Our design includes the microscope and the position detective sensor, not limited in the body of the optical tweezer. We can manipulate the sample and then observe the image obtained in real time. Position detection sensor also plays a very important role in studying the dynamics of the system. We will build the optical tweezer horizontally to reduce the noise due to instability.

The exceptional optical sensors are made by using the optical tweezer in our lab. For example, the Bio-sensing and medicine delivery depend on the physical properties of the cell surface, as well as many mechanisms of biological behaviors. The focus of my research is on the membrane of the cancer cell, and expansion of my technique to study cell interior, especially the mitochondria and nucleus, which are very important in understanding cancer metastasis.

Current Activities: The design of the optical tweezer and the purchase of components to build an optical tweezer is complete and the initial assembly and calibration of the laser is almost completed. Several training courses in nanofabrication and cell culture have been under taken to build the needed technical background in biological systems.