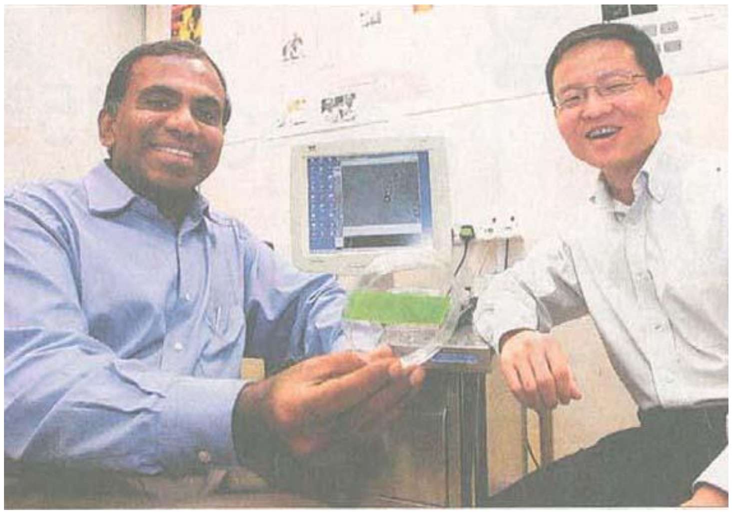
"Stiff red blood cells" and the "Ultimate code"

Source : Lianhe Zaobao (20 July 2006)

An Interview with the winners of NUS Centennial Professorships.



After falling sick, your body feels uncomfortable and your limbs stiff. However, do you know that red blood cells also become stiff when you are ill?

Scientists discovered long ago that red blood cells become stiffer and stickier when infected with malaria. Consequently, these cells cannot squeeze to pass through blood capillaries thus failing their task of bringing nutrients and oxygen to the various parts of the body.

A normal red blood cell is about 8 micrometres in diameter. It has to contract to about 2 to 3 micrometres before it can pass through capillaries.

Scientists have always believed that malaria-stricken red blood cells are 3 to 4 times stiffer than normal ones, until the Massachusetts Institute of Technology (MIT) and the National University of Singapore (NUS) achieved a research breakthrough which proves that malaria-infected red blood cells are actually ten times stiffer.

It is difficult to imagine how research on the stiffness of red blood cells might be conducted. First of all, red blood cells are merely 8 micrometres in diameter, or less than one-tenth the diameter of a strand of hair. To investigate the stiffness of red blood cells, the MIT-NUS research team first developed a unique and revolutionary pair of optical tweezers. Researchers use the tweezers to apply stretching force on the red blood cells and thereby measure their stiffness.

The force applied by the optical tweezers on a red blood cell is merely in the range of tens to hundreds of piconewtons. The Newton is a unit to measure force. To put it simply, a 60-kg person exerts about 600 newtons of force on the earth. The piconewton is not just micro in scale. 1 piconewton is one-trillionth newton, and one picosecond a trillionth of a second.

The most current and advanced research that takes place on this scale is called nanobiomechanics. The MIT-NUS team is jointly led by Professor Subra Suresh of MIT and Associate Professor Lim Chwee Teck of NUS. Professor Suresh was recently awarded the “Tan Chin Tuan Centennial Professorship.”

Professor Suresh said that it is no news that disease destroys cells. However, with advances in technology, scientists have not just studied the mechanics of the human skeleton and the circulation of body fluids, but also delved into nano-scale cell mechanics. The kind of force applied on cells often has piconewtons as its unit. Scientists believe that, if the microscopic mechanical effects on cells can be captured, it would be possible to further understand the mutation of cells.

“I have to say that this is research that builds a new knowledge structure of its own. We can’t foresee what kind of medical breakthroughs it will bring. This will depend on how pharmaceuticals use the new knowledge.”

However, this does not mean that the new knowledge created by nanobiomechanics is useless at the moment. Professor Suresh revealed that he has already begun working with a medical equipment manufacturer to develop a portable malaria carrier detector.

Malaria is caused by four different parasite strains. Red blood cells infected by different strains can take on different degrees of stiffness. Once the MIT-NUS team identifies these four kinds of stiffness, it would be possible to distinguish between the different strains of malaria.

“This helps medical workers diagnose the kind of malaria the patient is infected with. From what we know, not every kind of malaria is fatal, so medical workers can treat patients who are infected with more severe forms of malaria first.”

Both Centennial Professors make significant contributions to R&D

NUS awarded the “Tan Chin Tuan Centennial Professorships” and “Lee Kong Chian Centennial Professorships” this May using donations from the Tan and Lee Foundations. The Lee Foundation set up by late philanthropist Lee Kong Chian, and the Tan Foundation set up by former OCBC Chairman Tan Chin Tuan, donated $30 million and $29 million respectively to NUS last year. NUS has set up four “Tan Chin Tuan Centennial Professorships” and two “Lee Kong Chian Centennial Professorships” with the donations.

The two Centennial Professorships are the most prestigious professorships awarded by NUS. Winners of the professorships have achieved outstanding breakthroughs in their fields of study, besides contributing significantly to academic policy and planning at their respective institutions. The winners will collaborate with NUS professors to help the university contribute more in R&D.

Professor Artur Ekert from Cambridge University is the winner of the Lee Kong Chian Centennial Professorship. He has stellar achievements in quantum mechanics, quantum computing and quantum cryptography.

The quantum is a basic, physical particle. Examples include photons, electrons and quarks. According to quantum mechanics principles and laws, no one other than the sender and recipient can grasp the state of a quantum or duplicate it. Any action to eavesdrop will change the state of the quantum, and will certainly be discovered by the recipient.

In other words, any action eavesdrop will alter the information originally carried by the quantum. It is not possible to get the key from the quantum, so quantum cryptograms are absolutely secure.

Professor Ekert is collaborating with Associate Professor Christain Kurtsiefer and Assistant Professor Lamas Linares Antia from NUS to develop a quantum cryptographic technology called the “Ultimate Code.”