Some 500 scientists were in Singapore this week for a conference to celebrate the opening of the Nanyang Technological University’s school of physical and mathematical sciences building. Liaw Wy-Cin and Grace Chua spoke to some of them about their work and the challenges ahead.

Nobel laureates (from left) Rudolph Marcus, Richard Ernst and Anthony Leggett continue to work hard to make new discoveries in their respective fields despite winning one of science’s top prizes. ST PHOTOS: SAMUEL HE

Three Nobel laureates share their latest findings

Professor Rudolph Marcus, 86, American, from the California Institute of Technology, United States

Won the Nobel Prize in Chemistry in 1992 for his work on the transfer of electrons between molecules in solution during a chemical reaction.

Prof Marcus spoke about how the action of some enzymes, which are biological substances that speed up chemical reactions, is independent of temperature.

However, he highlighted one particular enzyme, which is quite flexible at temperatures above 30 deg C, but becomes quite rigid and stiff below 30 deg C, thus impeding its ability to catalyze reactions.

The professor also mentioned that organic substances are usually not water-soluble, but they react well and faster when shaken in water, compared to an organic solvent.

Scientists have discovered that the particles on the surface of the water are responsible and are trying to find out how to make organic substances dissolve better in water.

They are hoping water can replace organic solvents as a “greener” solvent to be used in industrial processes.

Professor Richard Ernst, 76, Swiss, from the Swiss Federal Institute of Technology

Won the Nobel Prize in Chemistry in 1991 for his contributions to the development of nuclear magnetic resonance (NMR) spectroscopy.

NMR is now widely used in medical imaging, with Prof Ernst contributing significantly to increasing the sensitivity and resolution of the instruments.

The technology is based on the nuclei of atoms responding to a radio frequency electromagnetic field. Older technology used a sequential method in which pulses were applied one at a time.

He came up with a method in which multiple pulses could be applied at the same time, “getting all the nuclei excited at the same time”, he said, speeding up the process.

He also talked about how science allowed him to further indulge in his love of Tibetan paintings. He described how certain types of lasers could reveal information about their pigments.

He said: “We can know what sort of pigments were used in which parts of the painting and we can find out the age of the painting by the age of the pigments. We can also find out where the painting came from because different parts of the world use different kinds of pigments.”

Sir Anthony Leggett, 71, British, from the University of Illinois at Urbana-Champaign, United States

Won the Nobel Prize in Physics in 2003 with two other scientists for their work on two phenomena in quantum physics: superconductivity and superfluidity.

Superconductivity is the flow of electrical current without any resistance, while superfluidity is the flow of fluid without any resistance.

He was knighted in 2004 for his services to physics.

He spoke on issues facing the ultimate goal of creating a quantum computer – a super computer which can work a lot faster than current computers.

One problem, he said, related to the concept of superposition, which looks at the nature and behaviour of matter at a sub-atomic level.

The principle of superposition says that all states of an object are possible – for example, alive or dead – at the same time, as long as we do not look to check it.

Scientists are looking for ways to distinguish between the various states. This distinction can help in the computational prowess of a quantum computer.

More green solutions under the sun

BY GRACE CHUA

When people try to find alternative energy sources to combat global warming, solar power is often bandied about.

But current technologies are not very efficient at converting energy from sunlight to power, which solved the efficiency problem millions of years ago.

In a process called photosynthesis, green plants convert sunlight and carbon dioxide into oxygen, water and sugars.

Chemist Chen Hongyu (below) of Nanyang Technological University is trying to mimic that process.

Meanwhile, he is developing new techniques that could have other applications. In plants, a key step in photosynthesis involves using the sun’s energy to create a negatively charged electron and a positive particle.

The excited electron starts a cascade of events that eventually turn carbon dioxide into carbohydrates, while the positive particle eventually causes water to be split to make oxygen.

Previously, researchers were able to replicate this process, but the resulting energised chemicals are free-moving and thus quickly react with one another.

Dr Chen’s group uses nanotechnology – engineering on the scale of atoms and molecules – to solve this problem.

The team created tiny nanometer-size, self-assembling polymer capsules that can trap and hold electrons to separate them from the positive particles, the same way soap forms a capsule around a speck of grime to separate it from water.

In each capsule, they placed semiconductor nanoparticles that collect light energy and channel it more efficiently into the water-splitting process.

The project is still in progress, Dr Chen says.

But the polymer-capsule work might have biomedical and industrial applications, for example, different materials in a tiny polymer shell could be used to label molecules, or for drug delivery.

And some day, the water-splitting half of the photosynthesis process could be used to collect hydrogen for fuel cells.