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# "Bridging Between Science and Engineering"

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Science and engineering are so closely related in these days that it is often said that they are no longer separable. Nonetheless, we should note that science is driven mainly by our desire and efforts to understand how things work, whereas the motivation for engineering is to create and employ things and systems for the benefit of human beings. In this talk, we select examples of "science based engineering" and "engineering-based science" with emphasis on solid-state materials and devices, and examine roles and potentials of creative interactions between scientific minds and engineering spirits.

Prototypical technologies, such as the making of ceramic wares and metal tools, were developed mostly by the trial and error approach to satisfy daily needs of human beings. In modern engineering, however, its products, such as transistors, lasers and photo- detectors, often use and control microscopic processes of electrons and photons. Hence, most of them can be designed and built only by fully employing scientific concepts, methods, and knowledge, which are based mainly on classical and quantum mechanics, electromagnetisms, and quantum electrodynamics. A good example of "science-based engineering" is the field of nanoelectronic; there, electrons and photons are ingeniously controlled by employing nanostuctures so as to provide desirable device functions and performances. We discuss a couple of recent topics on quantum-dot, quantum-wire and quantum well devices in relation to future prospects of electronics and photonics.

We then examine key roles that engineering plays in the advancement of sciences. Telescopes, microscopes, spectrometers, and other instruments, made by advanced engineering, are truly indispensable for the discovery of new phenomena and the proof of theories. Recent successes to detect the neutrino oscillation (Totsuka et al) and the after-glow signal from a supernova of 12.9 billion light years away (Iye et al) by the use of advanced CCDs and PMTs are good examples. Note also that a good number of important discoveries were made in engineered nanostructures, as exemplified by the Esaki diode, the Josephson junction, and quantum Hall devices. In addition, critical roles that computers have played in computational sciences and data analyses, such as the deciphering of human genome, need to be appreciated and strengthened.

Finally, we discuss the need of expanding the forefronts of scientific and engineering research by interacting more with social sciences and humanities so as to provide intellectual solutions to key problems that human beings and our globe face today.