講座大師何志明（Wilson, Chih-Ming Ho）演講與對談一

生物科技工業的奈米技術
Nano Technology for Bio Industries

綱要：
奈米機電系統技術(NEMS)可以製造微小的感測器和驅動器，來感應與探索許多領域中的自然現象。我將在演講中討論生物特性探測系統中利用 NEMS 的研究方向及技術。也將闡明如何在不同數量級的尺寸內傳輸液體與它包含的顆粒。在不同的尺寸控制液體流動的物理特性是很不一樣的，假設在連續體正確時，極大的黏性耗散將使電動力比壓力更有效驅動，但在尺寸變小後，連續體不適用的情形下，分子作用力就變得最為重要了。
利用 NEMS 為主的光學或電化學的感測器，能既快速又精確識別生物分子。控制表面分子的性質是決定效率的重點。微小生物特性感測器配合以奈米或微米流體力學為基礎的材料預備系統能製造出診斷及治療特殊位置的儀器。

Nano-Electro-Mechanical-Systems (NEMS) technology enables us to develop miniature sensors and actuators, which can be used to sense and to exploit natural phenomena in a wide range of disciplines. In this presentation, we will discuss the technology and the research trend of applying NEMS to control flows for sample preparation in bio-signature detection system. We will illustrate how to facilitate transports of fluids and embedded particles with length scales varying in several orders of magnitude. The underlying physics of controlling fluid flows over a vast change of length scale are very different. In the regime where continuum assumption still holds, the extremely high viscous dissipation makes the electrokinetic forces a much more effective actuation than the pressure. Further reduction in length, the molecular forces becomes dominating and continuum assumption breaks down.
With MEMS based optical or electrochemical sensors, we can identify bio-molecules in a rapid, sensitive and specific manner. Controlling the surface molecular properties becoming the key performance issue. Micro bio-signature sensors in couple with the micro/nano fluidics based sample preparation system enable us to realize the instrument for point-of-care diagnoses.

講座大師何志明（Wilson, Chih-Ming Ho）演講與對談二

跨領域訓練 - 未來科學家及工程師的教育趨勢

Educating the Future Scientists and Engineers with Interdisciplinary Training

綱要：

所謂領域是對自然知識以人為方式劃分而得。但今日領域的界限不應再墨守成規，這些領域是在五十年前訂定的。總有人認為跨領域的知識不如流體力學、固體力學等知識來得重要，事實上，跨領域訓練和基本知識並不是一條直線的兩端那麼極端對立，而應是一個圓的兩點，問題是如何對基本知識定義。

隨著人類基因組計劃的成功，處理奈米分子、DNA 和蛋白質已經變成醫療保健產業的主流。資訊學是處理沒有質量的資訊，傳統的訓練並不包括處理沒有質量以及奈米尺寸的物質。我們必須提供學生更多物理、化學、生物以及數學深入的訓練，學生需要的是這些領域的基本知識。

那麼傳統的領域如流體力學應如何符合這些改變？在大多數流體力學教科書的首頁，都假設物質為連續體，換言之，分子效應是以一些物理常數取代。在微機械或生物科技的發展中，尺寸不斷縮小，而分子效應變得更重要。除了古典連續體力學外，學生更應該知道更多奈米微米尺寸效應，因此需要加強物理、化學、生物以及數學的訓練。

現在的學生畢業之後將面對往後四十年的工作生涯，沒有人能預言二三十年後將面臨的重要挑戰，即便是生技和資訊產業也都可能不是主要的挑戰。要培養學生具備在瞬息萬變世界中不斷面對新的挑戰的能力，跨領域訓練無疑能提供更寬廣的知識及基本的科技訓練。

Discipline is an artificial division of natural knowledge domain. Discipline boundaries should not be held in a very rigid manner as at present. The current disciplines were defined more than fifty years ago. Different voices always suggest that interdisciplinary knowledge is not as fundamental as fluid mechanics, solid mechanics, etc. In fact, interdisciplinary training and fundamental knowledge are not at the two ends of a long straight line. They are at two points on a circle. The key point is the definition of fundamental knowledge.

With the success of the human genome project, handling nanoscale molecules, DNA and protein has become the main stream in the health care industry. Informatics is the technology of handling massless information. Traditional training does not handle massless and nano-scale matters. We need to provide students with much more in-depth training in physics, chemistry, biology and mathematics. The fundamental knowledge of these areas is the needed education for students.

How should classical disciplines, e.g. fluid dynamics, conform to the changes? On the first page of most fluid dynamics book, the assumption of continuum is taken. In other words, the molecular effects are represented by physical constants. While interesting length scale keeps decreasing in developing micro machines or biotechnologies, molecular effects become important or even dominating. In addition to the classical continuum mechanics, students deserve to know more about nano/micro scale effects. Resorting to deep training in physics, chemistry, mathematics and biology is the solution.

The current students graduating today will have a forty year career in front from them. No one can predict what will be the challenges a few decades from now. Even bio-tech and informatics will most likely not be the leading challenge anymore. Equipping students to be able to face the challenges in a fast changing world, interdisciplinary training will provide the breadth and the fundamental scientific training that will provide the skills to adapt to these changes.