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DR. JOHN MALONEY FROM MASSACHUSETTS INSTITUTE OF TECHNOLOGY JOINED US ON CAMPUS FOR A TALK HOSTED BY THE FACULTY OF SCIENCE AND TECHNOLOGY (/EVENT/DR-JOHN-MALONEY-MASSACHUSETTS-INSTITUTE-TECHNOLOGY-JOINED-US-CAMPUS-TALK-HOSTED-FACULTY)

Drug Delivery to Cell Mechanics: Adventures in Materials Science

Dr. John Maloney from Massachusetts Institute of Technology joined us on campus for a talk hosted by the Faculty of Science and Technology

By Agustinus Law, Alexandra Vanessa, Rika Luh

Jakarta, 4 July 2015 –Dr. Maloney from MIT gave a seminar at Sampoerna University about his experiences and interests in Mechanical Engineering research. The seminar was attended by about 35 audience members from both engineering students and mixed faculty. The room was brimming with excitement as he began to tell us stories about various engineering and research concepts at a fast pace.

As the presentation began Dr. John immediately posed to us ideas that many of us do not usually think about such as a metal's vapor pressure and very small mechanical objects that he has made. Then he went on to explain at length about what he considers a material perfection, a silicon boule, single crystal ingot produced by slowly growing them out from pure molten silicon. Producing a material with perhaps only 1 part-per-quadrillion of flaw. This flawless material is the basis of our microprocessors where billions of transistors are built onto an area no larger than an inch squared.

Dr. Maloney then shared with us his experience in MicroCHIPS, a company that specializes in drug delivery with implantable chips. The way the chip would work is by storing a drug reservoir containing hundreds of doses which is then implanted inside the body to deliver the drug over time. Based on commands from perhaps a remote control sending impulses, the chip would then melt the reservoir seal made of gold, releasing the appropriate dose. This process is called electro thermally activated microchips.

Molten metals inside a living organism seems very dangerous, but he assured us that the scale at which it is operating it is safe. "It's so tiny and so fast, that it wouldn't harm anything." The energies involved won't have a significant effect to the surrounding environment.

On the other hand it's not so easy to convince investors about its safety, demonstrating to us the difficulty of pitching new ideas especially in medicine. In the end the company seemingly had no problems gaining investments, as it has raised north of 75 million dollars within 15 years. A student asked if there has been a commercial product yet, and Dr. Maloney explained there has not been a product as the timeframe of new technology research may be very long, as expanded by Dr. Patta (Dean of FST) on how new technologies can require many years of development.

Limitations of the microchip is how it might slowly dissolve over time inside an organism, thereby limiting its lifetime. Another limitation is the inherent security risks in holding many doses at a small area. Dr. Maloney explained to a student that in the event should the chip break, perhaps from a physical trauma, it might release potentially dangerous amount of drugs inside the person. That is one factor why it takes such a long time to design a secure chip. And with anything electronically controlled, there is always fear of unauthorized tampering. Another student points out the possibility of hacking the device. And Dr. Maloney agreed that this is a factor that has been considered by the IT department of the company.

As the chip can be a very useful device in the future of medicine, FST Lecturer Maria Wahyuni, M.Ds asked from a design perspective how many chips a human can handle. Dr. Maloney remarked that the present size of the chip is already big enough, and we cannot put too many inside a human as we do not have too many empty spaces. This also limits what types of drugs that can be stored inside; drugs such as insulin which are regularly needed would be more challenging to implant.

After working at MicroCHIPS, Dr. Maloney became inspired with cell mechanics. Dr. Maloney referred to a cell as “the most amazing mechanical object.” He showed us load bearing and force detection on cells, which has been difficult to measure until the development of new experimental methods.

One such method is to isolate a cell and carefully subject it to pressure generated from light. By varying the light intensity one can measure the mechanical properties of the cell. But all cells, as with most objects will not have exactly the same properties. Then statistics and probability will do well in predicting a cells behavior after enough samples are analyzed, especially when dealing with large structures comprising of large numbers of cells, such as would be encountered in tissue engineering.

Recognizing the possibilities within cell engineering, a student asked whether it is possible to enhance weaknesses that senescence introduces, such as that of weakening bone structure and nerve connections. Dr. Maloney answered that it is currently studied as three dimensional models to analyze the behavior of both the bone’s overall structure and how each minute element fit into each other.

Dr. Maloney then ended the seminar and remarked that there is a very vibrant and active community conducting these research projects. We very much enjoyed his talk and learned some very interesting things related to mechanical engineering.

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