The Chinese University of Hong Kong

Department of Biomedical Engineering

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Venue: Room 215, William M.W. Mong Engineering Building, CUHK

In Vitro Fertilization on a Chip

Prof. Jeffrey Da-Jeng YAO

Professor

Department of Power Mechanical Engineering
Institute of NanoEngineering and MicroSystems
Department of Engineering and System Science
National Tsing Hua University, Taiwan

Abstract

The in vitro fertilization (IVF) is an important technique in biological and clinical studies since 1970. In recent years, microfluidic system has been widely used in cell detection or position a single-cell level, including the mechanical, optical, electromagnetic fields due to the advantages of biocompatibility, high-precision, low-cost, disposable, and easy to reproduce etc. In this presentation, we propose three different types of microfluidic systems, the imitation oviduct microfluidic chips, to enhance the probability of embryo fertilization for Oligozoospermia patients.

At the first of the continued microfluidic chip, the motile sperms from the oligozoospermia patients can be separated by using microfluidic chip based on its laminar flow. Then to imitate the oviduct, the oocyte can be effectively position by dielectrophoresis (DEP) technology, and it will be reacted with those motile sperms to form embryo under proper cultural environment. Finally, the reacted oocyte, embryo, was moved to incubator for further culture. The embryo can be cultured successfully after three and an half day, that is comparable with the one by using traditional IVF.

In contract with continued microfluidic system, two types of droplet-based microfluidic system would be presented. The dynamic culture is demonstrated with a system for EWOD that can manipulate a single droplet containing one mouse embryo to mimic the path from an oviduct to a uterus. A static mouse embryo culture on EWOD chips is presented for comparison with the results of dynamic culture. According to the dynamic and static results, the rate of embryo cleavage to hatching blastocyst with a dynamic culture is greater than that with a static culture. The EWOD system can enhance the culture of mouse embryos in a dynamic environment. Another droplet-based microfluidic system will also be shown, not just only for the embryo droplet formation from sperms and oocyte, but further for dynamic culture in the microchannel.

Biography

Dr. Da-Jeng Yao is a Professor at Department of Power Mechanical Engineering and Institute of NanoEngineering and MicroSystems (NEMS), also an adjunct Professor at Department of Engineering System and Science, National Tsing Hua University, Taiwan. He received his MS from Department of Mechanical Engineering, Lehigh University in 1996, and Ph.D. from Department of Mechanical and Aerospace Engineering, University of California at Los Angeles (UCLA) in 2001.

His research can be divided into four categories: Bio-sensing system, including proteins and amino acids detection, DNA sequencing recognition, and electronic nose for odd vapor detection; Neuron Engineering, including multi-electrode arrays for brain research; Bio-sample preparation system, including EWOD (Electrowetting on Dielectrics) on micro fluidic system and surface modification of magnetic nanoparticles for drug delivery development; and Microfluidic Reproductive Medicine on a chip, including motile sperm separation and embryo formation on a digital microfluidic chip. More than 80 journal papers were published at top journal among this research field, including Biosensors and Bioelectronics, Nanotechnology, Carbon, Journal of Micromechanics and Microengineering, and Lap on a chip, etc.

He got Wu-Da-Yu Memorial Award (Young Investigator) from National Science Council in 2009, Shen-Yin award in 2010, Young Researcher from Society of Theoretical and Applied Mechanics of the Republic of China in 2012, National Innovation Award in both 2012 and 2014, and Nanoscience Award by Publishing Division of Cognizure in 2015. He was awarded as ASME fellow since 2013, and RSC fellow since 2018.

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For enquiries, please contact Ms. Christine Ko, Department of Biomedical Engineering at 3943 8278