

Nanochip-induced epithelial to mesenchymal transition: impact of physical microenvironment on cancer metastasis

Udesh Dhawan¹, Ming-Wen Sue², Kuan Chun Lan², Waradee Buddhakosai², Pao Hui Huang², Yi Cheng Chen³, Po Chun Chen³, Wen Liang Chen²

¹Department of Materials Science and Engineering, National Chiao Tung University, 1001 University Road, Hsinchu, Taiwan, 300, ROC

²Department of Biological Science and Technology, National Chiao Tung University, 1001 University Road, Hsinchu, Taiwan, 300, ROC

³Department of Materials and Mineral Resources Engineering, National Taipei University of Technology, 1, Section 3, Zhongxiao E. Rd, Taipei, Taiwan, 10608, ROC.

Epithelial-to-mesenchymal transition (EMT) is a highly orchestrated process motivated by the nature of physical and chemical compositions of the tumor microenvironment (TME). The role of the physical framework of the TME in guiding cells toward EMT is poorly understood. To investigate this, breast cancer MDA-MB-231 and MCF-7 cells were cultured on nanochips comprising tantalum oxide nanodots ranging in diameter from 10 to 200 nm, fabricated through electrochemical approach and collectively referred to as artificial microenvironments. The 100 and 200 nm nanochips induced the cells to adopt an elongated or spindle-shaped morphology. The key EMT genes, E-cadherin, N-cadherin, and vimentin, displayed the spatial control exhibited by the artificial microenvironments. The E-cadherin gene expression was attenuated, whereas those of N-cadherin and vimentin were amplified by 100 and 200 nm nanochips, indicating the induction of EMT. Transcription factors, snail and twist, were identified for modulating the EMT genes in the cells on these artificial microenvironments. Localization of EMT proteins observed through immunostaining indicated the loss of cell-cell junctions on 100 and 200 nm nanochips, confirming the EMT induction. Thus, by utilizing an *in vitro* approach, we demonstrate how the physical framework of the TME may possibly trigger or assist in inducing EMT *in vivo*. Applications in the fields of drug discovery, biomedical engineering, and cancer research are expected.

Recent Publications

1. Dhawan U, Sue MW, Lan KC, Waradee B, Huang PH, Chen YC, Chen PC, Chen WL (2018) "Nanochip induced Epithelial to mesenchymal transition: Impact of Physical microenvironment on cancer metastasis". ACS Applied Materials and Interfaces.
2. Dhawan U, Wang SM, Chu YH, Huang GS, Lin YR, Hung YC, Chen WL. "Nanochips of Tantalum oxide nanodots as artificial microenvironments for monitoring ovarian cancer progressiveness" Scientific Reports.
3. Dhawan U, Lee CH, Huang CC, Chu YH, Huang GS, Lin YR, Chen WL. (2015) "Topological control of Nitric oxide secretion by Tantalum oxide nanodots arrays". Journal of Nanobiotechnology.

Biography

Dr. Udesh earned his Ph.D. in Biomedical Engineering from the Department of Materials Science and Engineering at National Chiao Tung University, Taiwan. He is currently a postdoctoral fellow at the Institute of Chemistry, Academia Sinica, Taiwan. He has published several articles in the field of Biomaterials and cancer biology. He serves as an editorial board member for the journal SF journal of Materials and Chemical Engineering and is the managing editor for the journal Frontiers in Bioscience. His research interests include engineering nanostructured biomaterials for cancer therapy, drug discovery and drug development.

udeshdhawan.91@gmail.com