



2015 中技社科技研究獎學金

CTCI Science and Technology Research Scholarship



圖案化磁性微薄膜結構之仿生/生醫應用

Micro-Patterned Magnetic Thin Films for Biomedical/Biomimetic Applications and Single-Cell Analysis by Magnetophoresis

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研究重點

Patterned soft magnetic thin films are capable of concentrating/guiding magnetic field lines and generating local stray fields from domain walls (DWs) after magnetized in an external field. Therefore, in this thesis, a patterned magnetic thin film with magnetic shape anisotropy were designed and fabricated into two-dimensional (2D) planer structure and three-dimensional (3D) rolled-up structure. Magnetic microbeads and magnetically labeled cells were attracted to be concentrated or located in the vicinity of DWs. The captured cells were then cultured to visualize their behavior or morphological changes. Furthermore, magnetic dot arrays were fabricated to modulate the local magnetic field and to assist ferrofluid divided into orderly arranged microdroplets. The microdroplets can be served as the mold to fabricate superhydrophobic biomimetic surface (ferrofluid-molding method). Magnetophoresis has been adopted in the design of separation and diagnostic devices while analytical techniques based on cell magnetophoresis have rarely been proposed. Here, cell magnetophoresis has been utilized to quantify the number of labeling MNPs that relates to intracellular hyperthermia. Besides, the fluorescence-based cytotoxicity assay was examined simultaneously to realize the possible threshold number of uptake MNPs lead to nanotoxicity. Lastly, cell magnetophoretic velocities were conducted to cells treated with hydrogen peroxide (H_2O_2) or absorbed with protein. The alteration in cell membrane properties has been found to affect the viscosity force during magnetophoresis.

研究成果

1. Micro-Patterned Magnetic Thin Films

Magnetic cell manipulation

Two dimensional structures

PloS One 2015, 10, e0135299.

Three dimensional structures

PloS One 2014, 9, e96550.

2. Single cell analysis by magnetophoresis

Quantification of MNPs number-Nanotoxicity

PloS One 2014, 9, e96550.

Ferrofluid-molding for biomimetic surface

Adv. Funct. Mater. 2015, 25, 2670-2676.

θ	tilt angle β	$W_{pin}/W_{release}$	$F_{pin}/F_{release}$
25°	15° ± 1.03°	1~13.3	1.37-18.31
50°	30.3° ± 2.07°		11.05-146.96
70°	55.4° ± 2.13°		2.67-35.54

Quantification of MNPs number-Intracellular hyperthermia

IEEE Trans. Magn. 2014, 50, 4003204.

Analysis of membrane property alternation

研究生活及心得

感激指導教授於研究上的支持以及授予創新思維，讓我於碩博連讀期間成功進行生物、磁學與工程之跨領域研究，使我得以拓展自身眼界；感謝實驗室學長學弟妹及朋友協助我克服困難；感謝父母的扶持讓我在求學的道路上無後顧之憂以及姊弟給予心靈上鼓舞與支持，期望我莫忘初衷秉持一貫認真態度未來發揮所長為社會國家做出貢獻。