2019「中技社科技獎學金」

2019 CTCI Foundation Science and Technology Scholarship

研究獎學金

Research Scholarship

Study on Structure Analysis and RRAM Application Development of One-Dimensional Metal-Oxide Nanomaterials

（一維金屬氧化物奈米材料之結構分析與記憶體元件應用發展）

國立交通大學 材料科學與工程學系所 博士班五年級　丁一心

指導教授　吳文偉 教授

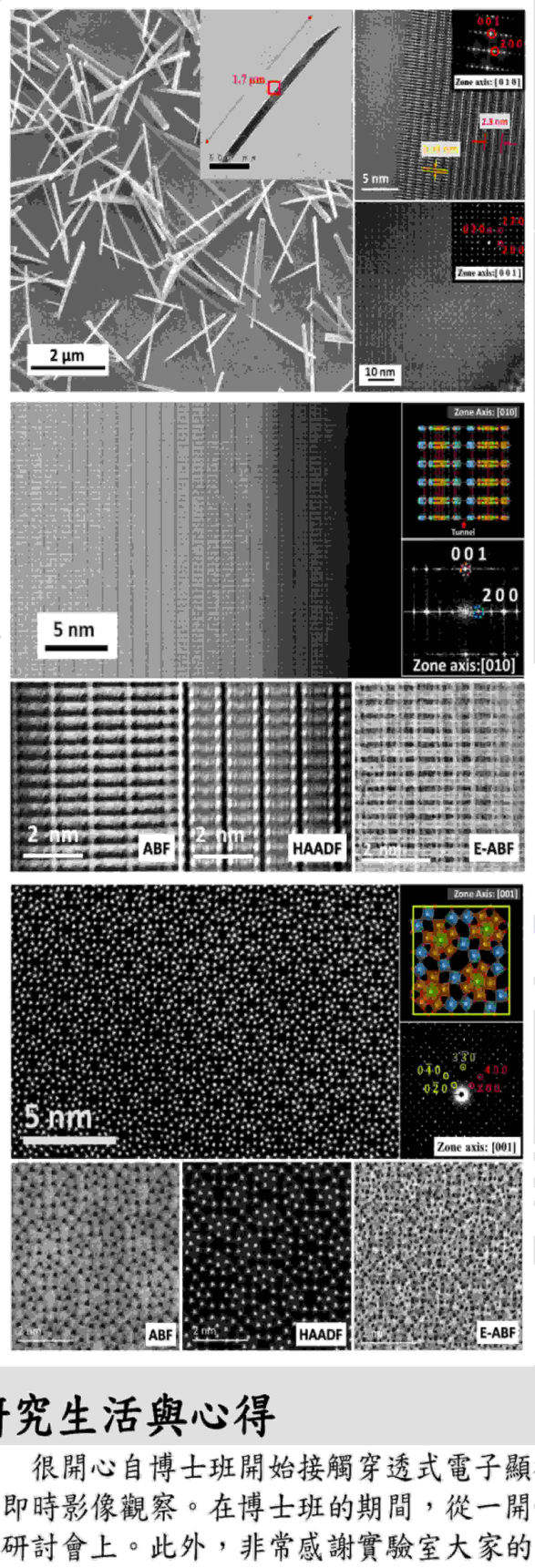
國立交通大學 National Chiao Tung University

NCTU Advanced Nanodeviced and Thin Film Lab

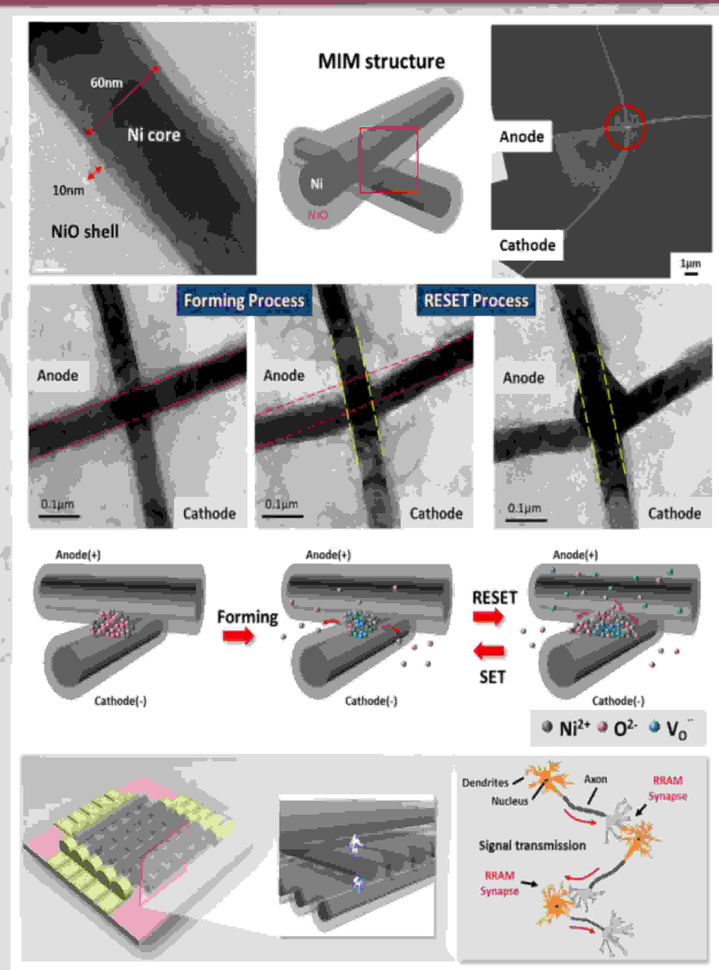
研究重點

One-dimensional metal-oxide nanowires have outstanding and promising applications. Nanowires, which have excellent physical and chemical properties, possess many advantages and benefit to overcoming the difficulties of scaling down. Utilizing the high-resolution transmission electron microscopy (TEM) to identify metal oxide nanowire is a good way to realiz the overall structure and electric/thermal reaction process with real-time record. Firstly, the molybdenum oxide (Mo_5O_{14}) nanowires, fabricated by CVD process, have extraordinary structures like tunnel structure and pseudo-lamellar structure in crystalline. In addition, it has the unique periodicity in the growth plane and interesting structures, which are all captured in different zone axes. Secondary, core-shell Ni-NiO nanowires are applied in the memristors. The crossbar center of Ni-NiO nanowires was observed by in-situ TEM in order to record the resistive switching behavior. Thirdly, HfO_2 layer is used to modify the NiO layer as switching bilayer, which could improve overall electrical properties. Therefore, we successfully identified the filaments, forming in the HfO_2 and NiO layers, and realized the switching mechanism. Finally, interesting diffusion behavior between ZnO nanowires and Fe metal was observed by using in-situ TEM. By controlling the annealing condition for the solid-state diffusion, porous Fe_3O_4 and unique ZnO/porous Fe_3O_4 nanowire heterostructures were formed.

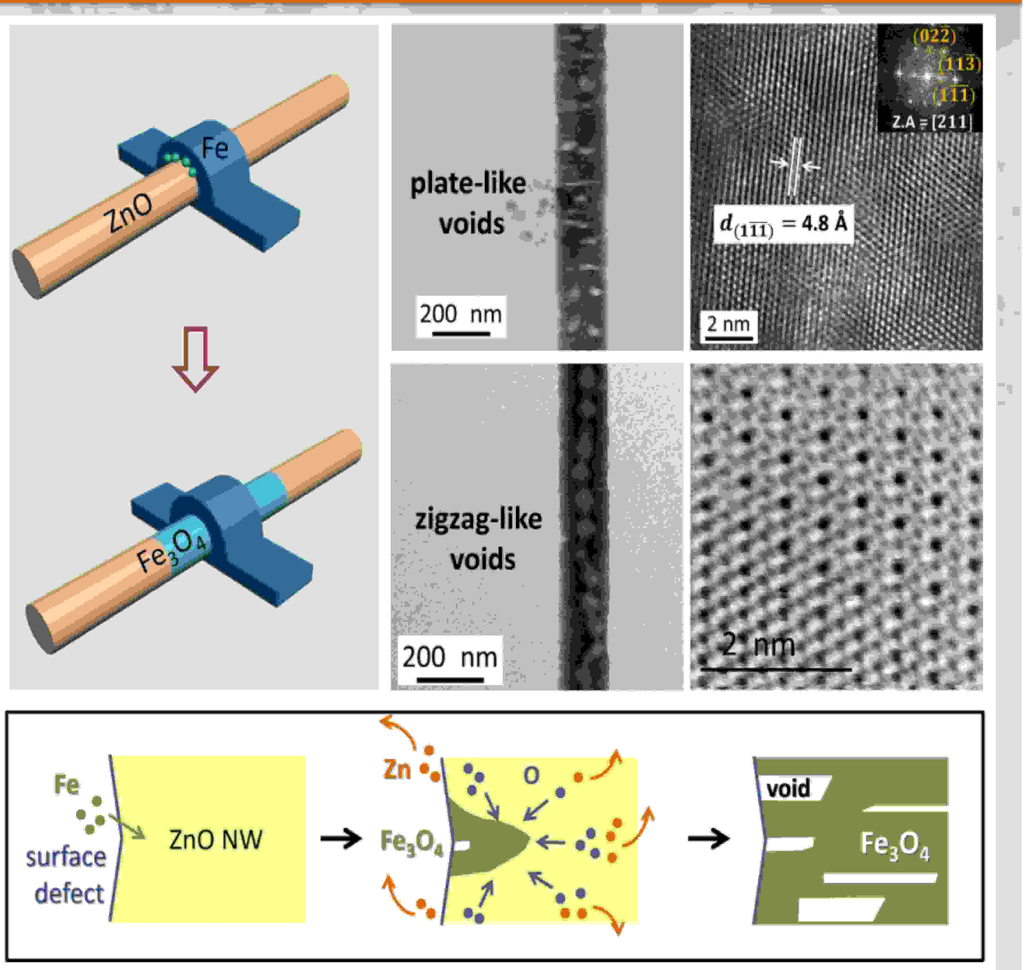
01 Atomic imaging of Mo_5O_{14} nanowires with unique and complex periodicity by advanced electron microscopy



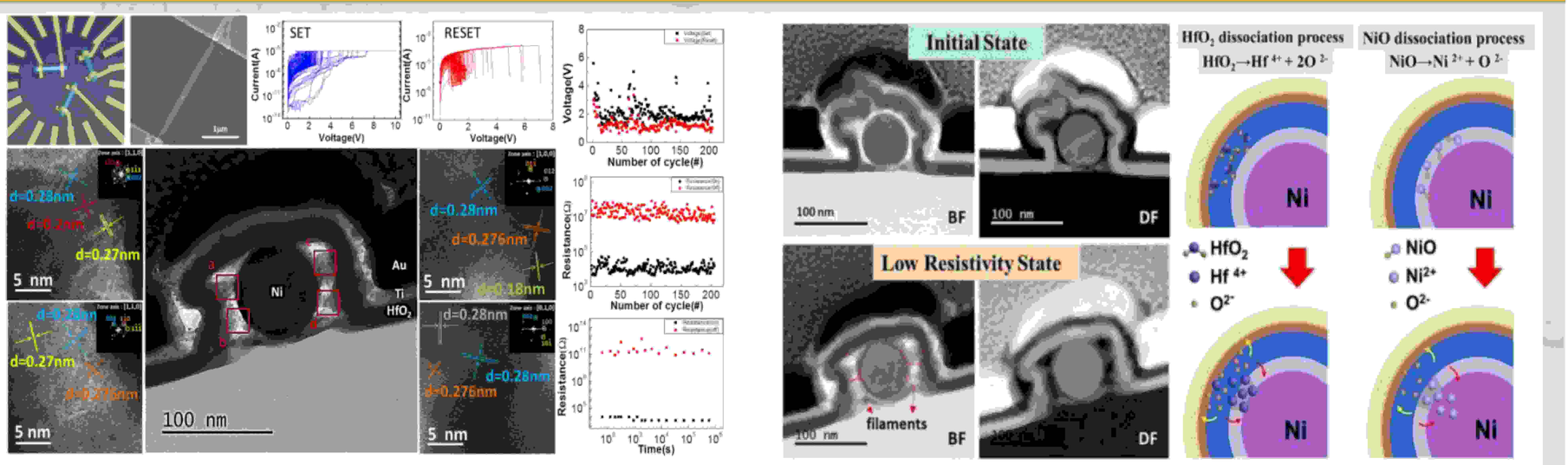
02 Observation of Resistive Switching Behavior in Crossbar Core-shell Ni/NiO Nanowires Memristor



04 Observing Solid-state Formation of Oriented Porous Functional Oxide Nanowire Heterostructures by in-situ TEM



03 Ni/NiO/HfO_2 Core/Multishell Nanowire ReRAM Devices with Excellent Resistive Switching Properties



研究生活與心得

很開心自博士班開始接觸穿透式電子顯微鏡的領域，並在吳文偉教授的指導下，我們利用穿透式電子顯微鏡針對一維金屬氧化物奈米線進行原子級的結構分析與通電加熱的即時影像觀察。在博士班的期間，從一開始對材料領域有點茫然，經過不斷的學習與挑戰，目前相關的學術論文已有六篇發表在國際頂尖期刊，同時也發表學術成果於國內外研討會上。此外，非常感謝實驗室大家的幫忙與吳文偉教授的對我研究生涯的指導，使我能學習到實驗研究的思維與方法，並在合作交流與待人處世方面也受益良多。最後，也非常感謝家人的支持與鼓勵，讓我在博士班期間有多采多姿的生活。