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得獎著作：

- J. Jiang, Y. Bitla, C. W. Huang, T. H. Do, H. J. Liu, Y. H. Hsieh, C. H. Ma, C. Y. Jang, Y. H. Lai, P. W. Chiu, W. W. Wu, Y. C. Chen, Y. C. Zhou*, **Y. H. Chu***, 2017, "Flexible ferroelectric element based on van der Waals heteroepitaxy", *Science Advances*, 3, e1700121

- Y. H. Hsieh, F. Xue, T. Yang, H. J. Liu, Y. Zhu, Y. C. Chen, Q. Zhan, C. G. Duan, L. Q. Chen, Q. He, **Y. H. Chu***, 2016, "Permanent ferroelectric retention of $BiFeO_3$ mesocrystal", *Nature Communications*, 7, 13199

- C. Y. Kuo, Z. Hu, J. C. Yang, S. C. Liao, Y. L. Huang, R. K. Vasudevan, M. B. Okatan, S. Jesse, S. V. Kalinin, L. LI, H. J. Liu, C. H. Lai, T. W. Pi, S. Agrestini, K. Chen, P. Ohresser, A. Tanaka, L. H. Tjeng, **Y. H. Chu***, 2016, "Single-domain multiferroic $BiFeO_3$ films", *Nature Communications*, 7, 12712

得獎簡評：

朱英豪副教授之著作主要以雷射分子束磊晶成長技術，開發以氧化物為主之多鐵（multiferroic）材料。此類材料同時具有特殊之鐵電性及鐵磁性，是目前凝態物理中重要之研究課題。朱教授利用在材料原子尺度結構操控的技術，成長高品質之材料，在此領域中具有相當的國際知名度。其代表作一利用磊晶技術在柔性雲母基底上製備新穎氧化物材料 $Pb(Zr,Ti)O_3$ 的單晶薄膜，是柔性電子材料相當大之突破。結果發表於 *Science Advances*（2017）。代表作二與三是開發多鐵材料 $BiFeO_3$ 單晶薄膜與奈米結構，提供低耗能電場控制自旋元件的解決方案與其背後原理之探討，兩篇論文皆發表於 *Nature Communications*（2016）。整體而言，朱英豪教授在複雜氧化物

材料磊晶成長之研究成果，在臺灣材料學界的年輕學者中表現相當傑出，並在國際上受到高度肯定。

得獎人簡歷：

Professor Ying-Hao Chu received his PhD in the Department of Materials Science & Engineering from National Tsing-Hua University in 2004. Then, he joined University of California, Berkeley as a postdoc. In 2008, he acquired an assistant professorship in the Department of Materials Science & Engineering at National Chiao Tung University. In 2013-2017 he had an adjunct position in the Institute of Physics, Academia Sinica. In 2014 he started an adjunct position in the Department of Electrophysics, National Chiao Tung University. In 2016, he started the adjunct positions in the Material and Chemical Research Laboratories, Industrial Technology Research Institute and the International College of Semiconductor Technology at National Chiao Tung University. His research is highly focused on complex functional oxides and strongly correlated electron systems. He has extensive experience in the use of advanced characterization techniques to understand and manipulate functional oxide heterostructures, nanostructures, and interfaces. His current goal is try to create a pathway to use high quality oxide heteroepitaxy for soft technology. Now, he is a pioneer with the most publication along this research direction. He has published more than 260 papers (Web of Science: >13000 citations, h-index=54; Google Scholar: >17000 citations, h-index=62) in academic journals. He is the winners of Outstanding Research Award of Ministry of Science and Technology of Taiwan (2017), Futuristic Breakthrough Technology Award (2017), Young Researcher Award of the Physical Society of Taiwan (2017), Wu Ta-You Award (2017), Young Researcher Award of the Materials Research Society Taiwan (2016), Young Researcher Award of the Taiwan Vacuum Society (2016), and Y. Z. Hsu scientific paper award in Nanotechnology (2015). His name is listed as one of Thomson Reuters Highly Cited Researchers in Materials Science (2014 & 2016).

得獎著作簡介：

Lattice, charge, orbital, and spin degrees of freedom in condensed matter determine the fundamental functional properties of materials, and the control of these degrees of freedom makes up the cornerstone of modern electronic devices. However, in the diligent pursuit of low-power-consumption, multifunctional, and environmentally friendly electronics, more sophisticated control of these degrees of freedom in new functional materials by external stimuli is desired. Multiferroics have recently provoked great scientific interest because those materials exhibit fascinating coexistence of and coupling between different order parameters and possess the potential to modulate one through another. Prof. Chu is a well-known expert on multiferroic materials. In recent years, several breakthroughs have been made by his group:

1. "Flexible ferroelectric element based on van der Waals heteroepitaxy", *Sci. Adv.* 3, e1700121 (2017).
   Flexible electronics is one such attribute that has attracted long-standing attention in today's energy-conscious world owing to their advantages of excellent portability, bendability, being lightweight and human-friendly interfaces. Perovskite lead zirconium titanate [$Pb(Zr,Ti)O_3$] having large ferroelectric polarization, fast polarization switching, high Curie temperature, and low coercive field. However, the integration of superior device performance of the single crystalline PZT with the current conventional flexible substrates is severely impeded by its lack of high-temperature growth. In this study, a direct fabrication of epitaxial $Pb(Zr,Ti)O_3$ on flexible mica substrate via van der Waals epitaxy was demonstrated. These single-crystalline flexible ferroelectric $Pb(Zr,Ti)O_3$ films not only retain their performance, reliability, and thermal stability comparable to those on rigid counterparts in tests of nonvolatile memory elements but also exhibit remarkable mechanical properties with robust operation in bent states and cycling tests. This study marks the technological advancement toward realizing much-awaited flexible yet single-crystalline nonvolatile electronic devices.
2. "Permanent ferroelectric retention of $BiFeO_3$ mesocrystal", *Nature Commun.* 7, 13199 (2016).
   Non-volatile electronic devices based on magnetoelectric multiferroics have triggered new possibilities of outperforming conventional devices for applications. However, ferroelectric reliability issues must be solved prior to the realization of practical devices. In this study, everlasting ferroelectric retention in the heteroepitaxially constrained multiferroic mesocrystal was reported, suggesting a new approach to overcome the failure of ferroelectric retention. These results suggest that the approach of improving the ferroelectric retention by clamping the crystal structure is practical. The permanent ferroelectric retention of the strain-confined $BiFeO_3$ mesocrystal presents a great leap toward realizing the non-volatile multiferroic devices.
3. "Single-domain multiferroic $BiFeO_3$ films", *Nature Commun.* 7, 12712 (2016).
   The strong coupling between antiferromagnetism and ferroelectricity found in $BiFeO_3$ generates high expectations for the design and development of technological devices with novel functionalities. However, the multi-domain nature of the material tends to nullify the properties of interest and complicates the thorough understanding of the mechanisms. Here we report the realization of $BiFeO_3$ in thin film form with single-domain behaviour in both its magnetism and ferroelectricity. The key ingredient of this study is to give the BFO film an in-plane anisotropic strain. Furthermore, by fabricating a $Co/BiFeO_3$ heterostructure, we demonstrate that the ferromagnetic moment of the Co film does couple directly to the canted moment of $BiFeO_3$. The realization of the single-domain multiferroic $BiFeO_3$ thin films provides insights into the fundamental interactions of $BiFeO_3$ and opens a promising path for engineering novel functional devices.

得獎感言：

非常感謝中研院頒給了我這麼有意義的一個獎，中研院年輕學者研究著作獎不只給予了年輕學者肯定，同時也給予了實質的協助，讓年輕人能更有籌碼地往下階段的研究路邁進。很感謝一路以來實驗室的夥伴們，因為有他們日以繼夜孜孜不倦地陪我衝刺著，才造就了我今日的輝煌。感謝科技部多年的支持與交通大學校方的協助，讓我的實驗室在硬體上能持續的更新；同時也感謝交通大學材料系與電物系的同仁在研究上不吝賜教，使我的學識能日益精進。中研院物理所與工研院材化所的合聘機會，更是讓我有機會與不同視野的高手切磋，導入了多元思考與視角，讓研究能跳脫既有思維大膽嘗試。謝謝我的家人與朋友，因有他們長期的支持，讓我在研究路上能越走越遠。最後祝福在這條路上我所遇見的每個人都能豐富圓滿。