Title: Electron Hopping Transport in Two-Dimensional Semiconductor - Zinc Oxide Nanoflakes

Dunliang Jian,[1†] Yen-Fu Lin,[2†] Jiangpang Zhai,[1] Irene Ling Li,[1] Shulin Wang,[3] Ping Hua,[1,4] Jian-Jhong Lai,[5] Ming-Ming Ku,[5] Wen-Bin Jian,[5,a] Shuangchen Ruan,[1,a] and Zikang Tang[6]

[1]*Shenzhen Key Lab of Laser Engineering, Key Lab of Advanced Optical Precision Manufacturing Technology of Guangdong Higher Education Institutes, and College of Optoelectronic Engineering, Shenzhen University, Shenzhen , Guangdong 518060, China*

[2]*Department of Physics, National Chung Hsing University, Taichuung, Taiwan, ROC*

[3]*College of Energy and Power Engineering, University of Shanghai for Science and Technology, Shanghai 200093, China*

[4]*Optoelectronics Research Centre (ORC), University of Southampton, Southampton, United Kingdom*

[5]*Department of Electrophysics, National Chiao Tung University, 1001 Ta Hsueh Road, Hsinchu, Taiwan, ROC*

[6]*Department of Physics, The Hong Kong University of Science & Technology, Clear Water Bay, Kowloon, Hong Kong*

Abstract

The sequential hydrothermal process is used to synthesize ZnO nanostructures on Si substrates. The synthesized ZnO nanostructures are inspected by scanning electron microscope and transmission electron microscope. They present a morphology of two-dimensional structures, named nanoflakes. The ZnO nanoflakes have a thickness of tens of nanometers. The energy dispersive x-ray spectrum reveals their compositions of only Zn and O elements. In addition, its crystalline structures are investigated by high-resolution transmission electron microscope. The nanoflakes are then dispersed for another morphology measurement using atomic force microscope and their average thickness is determined. The dispersed nanoflakes are contacted with metal electrodes for electron transport measurements. Through the analysis of electrical and temperature dependences of resistivity, it is confirmed that the electron transport in ZnO nanoflakes agree well with the theory of Mott's two-dimensional variable range hopping. The nature of two-dimensional electron system in ZnO nanoflakes points to the application of this two-dimensional semiconductor as new channel materials for electronic devices.

Biography

Dr James Dunliang Jian was awarded his PhD from University of Chinese Academy of Sciences, after that James pursued his postdoc in the University of Connecticut, USA in polymer and nanotech research. James has been a senior research scientist, Shenzhen University after he was affiliated as an associate professor of University of Shanghai for Science and Technology and an excellent young teacher selected by the Education Commission of Shanghai Municipality.