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Nan Guo

Infrared Photodetectors Based on Low-Dimensional Materials

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Doctoral Thesis accepted by the
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Supervisor's Foreword

In 2010, Dr. Nan Guo joined our group and began to study infrared photodetectors based on low-dimensional materials. Infrared photodetectors, which turn the invisible infrared radiant energy into easily measurable electric signals, are widely used in many fields, such as spectroscopy, night vision and object recognition. However, its development still faces many problems. The traditional response mechanisms cannot provide better device performance, which requires new materials and physical mechanisms. In recent years, the emergence of low-dimensional materials with unique properties, such as high carrier mobility, tunable bandgap, easy combination between different materials without lattice mismatch, provides new prospects to enhancing the performance of infrared photodetectors.

Dr. Nan Guo has made systemtic studies of infrared photodetectors through simulations and experiments. He analysed the response physical mechanism of low-dimensional materials including graphene, nanowires and transition metal dichalcogenides and proposed design schemes on the improvement of the device performance. Scanning photocurrent microscopy was used to investigate the photothermoelectric effect in graphene device. And, an active infrared imaging was performed using the graphene device as a point-like detector at room temperature. In order to solve the problem of weak light absorption in InAs nanowires, a core–shell-like structure was designed to realize photogating effect, thus achieving high-gain photodetection. A hybrid WSe_2-In_2O_3 nanowire structure was designed to solve the trade-off between the dark current and the photoconductive gain. We hope that the results presented in this thesis will provide useful insights into future researches of high-performance infrared photodetectors.

Shanghai, China
August 2018

Prof. Weida Hu

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Writing a thesis takes a lot of effort and time, but no worthwhile achievements could have been made without help from many people. The completion of this work is a good moment to perform the duty of returning thanks to them.

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Last but not least, I want to thank my parents for their love, care and encouragement, which have proven to be invaluable emotional support for me to move forward in pursuing both scientific discoveries and career advancement.

Beijing, China
August 2018

Dr. Nan Guo