Extended Abstracts of the 2016 International Conference on Solid State Devices and Materials, Tsukuba, 2016, pp217-218

D-6-01(Invited)

Kinetics of forming silicides in nanowires and nano-heterostructures

Yi-Chia Chou

Department of Electrophysics, National Chiao Tung University
1001 University Road, Hsinchi 300, Taiwan
E-mail: ycchou@nctu.edu.tw

Abstract

We report methods of silicide formation in nanowires, including the phase transformation kinetics by point contact reaction and sequential catalyst reaction, to form heterostructures in nanowires. The nucleation and growth are discussed. Furthermore, we discuss the bottom-up growth of GaN nanowires and the complex catalytic reaction.

1. Introduction

Many electronic devices, such as field-effect transistors, depend on achieving precise control of both a semiconductor nanostructure and its contact with the larger scale circuit. The control of the contact between nanowire and circuit is a key step that involves integrating different types of materials and bridging between length scales.

2. Results and Discussion

In recent years, IV and III-V nanowires have attracted significant attention. In Si nanowires, we show that silicide formation can occur through a point contact reaction and we demonstrate that the reaction shows different kinetics from those already known in thin film silicide technology. We discuss the strain effect on the nucleation and growth of silicides in nanowires with thermodynamic, kinetic, and strain energy implications.

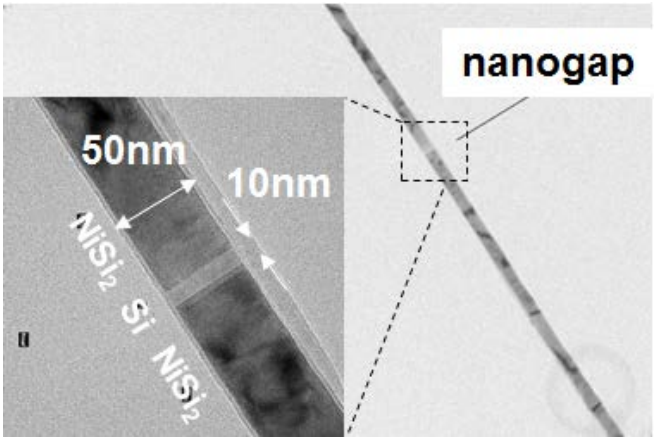

Fig. 1 Silicide/Si/Silicide heterostructure.

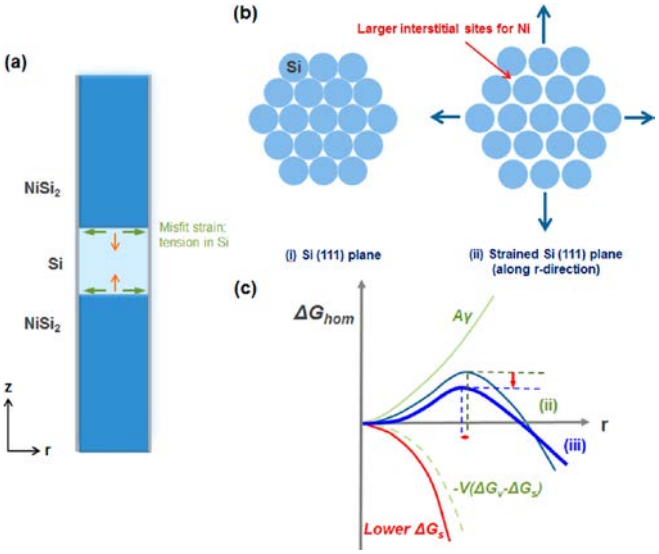

Fig. 2 Strain fluctuation and thermodynamic alternation during nucleation and growth of silicide

Such nanowires have an oxidized surface and this controls the reaction pathway and kinetics. However, if we examine silicide formation in VLS grown Si nanowires immediately after growth in ultra high vacuum, we find a different sequence of reactions, useful both for contact formation and also for modifying nanowire properties in new ways. The result is a nanowire with an epitaxial silicide inclusion, and it is possible to repeat the process to form multiple inclusions.

GaN nanowires grown on low-cost and large-size Si wafers are of interests. Here we report GaN nanowires grown on Si substrates by hydride vapor phase epitaxy (HVPE) using metal as catalysts. The microstructures and optical property will be shown. We suggest optimize growth parameters for mass production and the control of the luminescence.

3. Conclusion

The variety of nanostructures that can be formed using self-assembly potentially raises the chances for further device applications.

Acknowledgements

We would like to thanks the grants from Ministry of Science and Technology Taiwan and the Center for Interdisciplinary Science under the MOE-ATU project for NCTU.

References

[1] Y. -C. Chou, W. Tang, C. -J. Chiou, K. Chen, A. M. Minor, K. N. Tu, Nano Lett. **15** (2015) 4121.

[2] F. Panciera, Y. -C. Chou, M. Reuter, D. Zakharov, E. A. Stach, S. Hofmann, F. M Ross, Nat. Mater.**14** (2015) 820.