van der Waals Epitaxy of One-dimensional II-VI Nanostructures

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on behalf of Ezekiel Ogle

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Outline

• Introduction
• Experimental Setup and Procedures
• Results and Discussions
• Summary and Future Work
• Acknowledgements
Introduction
— Objectives

- Achieve high quality and uniform growth
- Employ CVD for heterogeneous growth
- Compare:
  - van der Waals epitaxy
  - Conventional epitaxy
Introduction
— What are II-VI Materials?

II-VI Semiconductors:
— Applications of II-VI Nanostructures

II-VI Nanostructures applications

• Photovoltaic conversion
• Light emission
• Photo detection
• High-energy radiation detection
Epitaxial Growth: van der Waals vs. Conventional

Conventional Epitaxy

van der Waals Epitaxy
Experimental Setup and Procedures
— Chemical Vapor Deposition System

• Home-made low cost CVD system with precision flow controller and wide-range vacuum gauge
• Temperature range: room temperature to 1000°C
• Pressure range: mTorr to atmospheric pressure
**System Setup**

**Temperature Profile**

- Measured Temperature (°C)
  - 600 °C
  - 700 °C
  - 800 °C
  - 900 °C
  - 1000 °C

- Distance from Center of Furnace (in)

**Experiment in progress!**

**Hot & Danger!**

- Electrical wires are exposed!
Results and Discussion
— ZnTe on Mica

Pressure
~50 Torr

Temperature
800 °C

Time
30 min

H_2
1.5 sccm
- ZnTe on 10 nm Au/Si

(a) (b) (d) (e)

Pressure ~50 Torr

Temperature 850 °C

Time 60 min

H₂ 1.5 sccm
-ZnTe Flag on 10 nm Au/Si
Summary

• ZnTe on mica
  — Tiny nanowires upstream of the source.
  — Downstream, the growth turned directly to a thick film
  — Film showing epitaxial growth

• ZnTe on Si with Au catalysts
  — Ultra-long micro-wires up to 20mm at high temperature zone: ~680 - 630
  — Ultra-long nanowires up to 10mm at medium temperature zone : ~630 - 575
  — Dandelion-like nanowires at low temperature zone : ~575 - 480
  — Flag structures waving under SEM
Future Work

• Modify temperature profile
• Study crystal structure and epitaxial growth relation
• Investigate the evolution of nanowires
• Improve crystal quality and uniformity
• Core-shell II-VI nanostructure
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