The Korgel Group: Nano

Brian A. Korgel
korgel@che.utexas.edu

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Semiconductor nanowires: a product of chemistry

\[ \text{Si atoms} \quad \text{Au nanocrystal} \]

\[ \text{Si nanowire - Au seeded} \]

0.31 nm

10 \( \mu \text{m} \)
Semiconductor Nanowire Applications

A New Materials Platform

- Li-Ion Batteries: $2.5B
- Exciton Energetics
- TFT Backplanes TAM $4.2B
- Thermal Pastes: $500M
- RFID Device TAM $1B
- SAM $147M (printed)
- NVM (Discrete) ~$25B
- Solar Wafers: $8.5B

Nanowire Thin Film Transistors

- NW Synthesis
- NW Device Fabrication
- NW Ink Formation
- NW Align & Deposition
- Surface Passivation

A new material for textiles applications, lithium ion batteries, photovoltaics

Non-woven Si nanowire fabric

Advanced, printable electronics based on semiconductor nanowires made in high throughput manufacturing scheme.
Semiconductor Nanocrystal Inks for Photovoltaics

Goal: Low cost high efficiency PVs

While solar panels are hot with homeowners for warming the house and saving electricity, they're often rejected as costly and tricky to install. Now engineers are racing to make a more consumer-friendly version. One attractive candidate is solar ink. Applied with a spray gun, the ink allows builders and homeowners to turn windows, doors, and roofs into power-generating panels. Just spray it on the way you would on a model airplane, says Brian Korgel, the University of Texas at Austin chemical engineering professor who invented the technology. (The ink can also be printed on plastic sheets using an ink-jet-type printer.) He expects the ink to be available in three to five years.
Figure 1. HRSEM images of sh-AB$_2$ BSLs on Si$_3$N$_4$-coated Si substrates with two different exposed BSL crystallographic surfaces: (a) (001) and (b) (100). Crystalline domains up to $\sim$9 $\mu$m in diameter were observed. Selected area electron diffraction (SAED) verified the presence of both Au and Fe$_2$O$_3$ nanocrystals in the BSLs (Figure S2 in Supporting Information).
NanoBio: Targeted imaging, photothermal therapy

Nanocrystals engineered with molecular recognition

Luminescent biocompatible silicon nanocrystals

B) Photoinduced heating of CuSe nanocrystals
Nanocrystals in Liposome (Vesicle) hosts

Questions: will hydrophobic nanocrystals embed in the vesicle membrane without disrupting its structure?

Is there a nanocrystal size limitation? (Membrane thickness is 3.7 nm)

Cryo-TEM image of a PC liposome loaded with Au nanocrystals

Image from: http://www.uzh.ch/onkwww/images/lipos4.gif