Contact-independent and High-resistance Measurement of Electrical Conductance of a Thin Solid Film with a Nanoscale Sensor
Technology #14921

Applications

High-resistance materials have applications primarily in solar energy harvesting and modern microelectronics.

Problem Addressed

For materials with excessively large resistance, traditional transport measurements fail because the current at reasonable voltages becomes too small to measure. By patterning hydrogenated amorphous silicon (a-Si:H) adjacent to a nanometer scale silicon metal-oxide semiconductor field-effect transistor (MOSFET), you are able to detect charging of the sample and measure extremely high resistances (~$10^{17}$Ω) using moderate voltages (~1 V). This device geometry, in which the MOSFET sensor and sample can be gated independently, allows investigation of the field effect and dispersive transport. Additionally, these techniques allow measurement of the density of localized states near the Fermi energy.

Technology

The charge sensor is an n-channel MOSFET that is electrostatically coupled to a strip of a-Si:H. The MOSFET is fabricated using standard techniques on a p-type silicon substrate. The n⁺ polysilicon gate of the MOSFET is patterned using electron beam lithography and reactive ion etching and tapers down to a width of ≈ 60nm. Because of its narrow width the MOSFET is extremely sensitive to its electrostatic environment.

Advantages

- Ability to measure extremely high resistances even in the presence of blocking contacts
- Ability to probe both field effect and dispersive transport
- Ability to extract the density of states near the Fermi Energy

Categories For This Invention:

- Electronics & Circuits
- Design & Fabrication
- Materials
- Nanomaterials
- Nanowires (Micro & Nanotech)
- Nanotechnology
- Thin Films
Intellectual Property:
Contact-independent electrical conductance measurement
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Publications:
Measuring Charge Transport in a Thin Solid Film Using Charge Sensing
American Chemical Society - Nano Letters
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External Links:
Kastner Group
http://web.mit.edu/kastner-group/

Image Gallery: