Docket #: S11-133

High Resolution Capacitance Bridge for Nano-structures

This patented technology is an Integrated Capacitance Bridge (ICB) that can perform ultra-high-resolution (aF), wide-temperature-range measurements of capacitance in nano-structures. The ICB has an operational range of 4K-300K and can measure at length scales 100x smaller than the current standard equipment. The ICB also uses a small excitation signal so that it can probe the electronic details of nano-scale structures without disturbing them. It can be used either as a stand-alone chip or integrated into a probe device for quality testing, measurement, or characterization of new and existing materials such as carbon nanotubes and graphene.

Stage of Research
The inventors have fabricated the ICB and tested it on top-gated graphene devices and carbon nanotube field effect transistors. These tests demonstrated that the ICB resolution was several orders of magnitude greater than a commercially available capacitance bridge.

Applications

- **Nanoscale testing and measurement** of capacitance spectrum for nano-structures or materials that exhibit quantum capacitance, including:
    - characterizing new research materials (such as carbon nanotubes and graphene) in computing devices and memory
    - quality testing existing materials

Advantages

- **Ultra high-resolution:**

    - ~10aF/rt(Hz) (orders of magnitude better than commercially available equipment)
    - data are not distorted by the large contact resistance that often exists at the interfaces of nano-scale devices
- **Wide-temperature range** - 4K-300K
- **Small excitation signal:**
    - signal amplitude smaller than kBT/q (compared to 10's of millivolts in current equipment)
    - can probe nano-devices without disturbing them

Publications

- Joseph A. Sulpizio, Arash Hazeghi, Georgi Diankov, David Goldhaber-Gordon, H.-S. Philip Wong, "An integrated capacitance bridge for high-resolution, wide temperature range quantum capacitance measurements", arXiv:10009.5407v1, Sept. 27, 2010.

Patents

- Published Application: 20130076378

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