Graphene Varactor uses Quantum Capacitance has Smaller Size and Higher Sensitivity

*Technology #20110133*

**Small Graphene Based Sensor Can Replace Microelectromechanical Based Sensors**

**Legacy Microelectromechanical Based Sensors**

Most wireless, charge-based sensors are based upon microelectromechanical systems (MEMS) technology, which are micron-sized electro-mechanical devices. Typically, the capacitance is tuned by changing the mechanical spacing between two electrodes. The resulting sensors are large and not well-suited for in vivo applications.

**Varactor Uses Quantum Capacitance of Graphene**

A graphene based variable capacitor varactor has been developed that operates based upon a quantum mechanical principle called the Pauli exclusion principle. The capacitance tuning is achieved because the quantum capacitance of graphene changes as a function of electron density in graphene. When charge (e.g., mobile ions in a solution) is near the graphene, the charge will change the electron concentration in the graphene. This change in the electron concentration changes the intrinsic (quantum) capacitance of graphene, which can be detected wirelessly as a frequency shift via a resonant oscillator circuit.

Learn about more groundbreaking discoveries at [www.research.umn.edu/techcomm](http://www.research.umn.edu/techcomm)
Applications Include Radiation Dosimetry and Brachytherapy

The result is a significant size reduction (around 1000x) compared to MEMS based wireless sensors. The graphene based sensor has significantly higher sensitivity in the detection of charge and a superior quality factor (Q) than alternative charge sensing devices. Since it is passive and does not require an external power source, the device will be low cost and suited to in vivo applications such as radiation dosimetry for accurate external beam radiation therapy and radioactive seeds (brachytherapy) as well applications such as monitoring blood glucose.

FEATURES AND BENEFITS OF GRAPHENE BASED SENSOR

- Significant size reduction (1000x) compared to MEMS based wireless sensors due to very high capacitance-per-unit-area (three orders of magnitude greater than other materials)
- High sensitivity and Q factor in the resonant circuit.
- Superior Q factor across the entire tuning range provides high quality wireless communication
- Passive power operation
- Lower cost

Inventors

Steven Koester, PhD

Professor, Department of Electrical and Computer Engineering, College of Science and Engineering

IP: UM Docket 20110133

For additional information, contact

Kevin Nickels
Technology Licensing Officer
exprlic@umn.edu
612-625-7289

Learn about more groundbreaking discoveries at www.research.umn.edu/techcomm