NEMS from Carbon Nano Structures

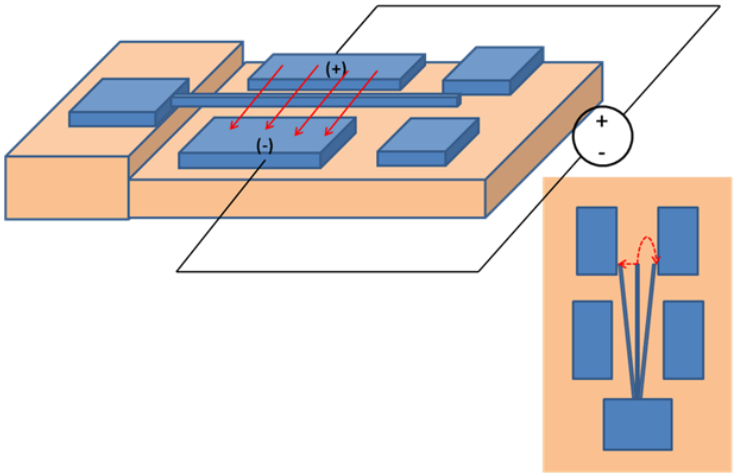
Trinity College Dublin

Available for Licence

Basic overview

Nano electro-mechanical systems (NEMS) are of interest in **high frequency, low power switching**, alternative circuitry and sensors. These devices can work under harsh conditions, e.g. **high temperatures and radiation environments**, and are defined by having critical structural elements at or below 100 nm. So far, many works have used top-down structures with silicon or silicon carbide to manufacture NEMs, however, more recently, bottom-up fabricated structures are being investigated to exploit the superiority of nano-carbon structures (NCs), such as graphene or carbon nanotubes (CNTs) as these materials exhibit unique mechanical and electrical properties.

Researchers in CRANN, Trinity College Dublin, can **create NEMS using carbon** (glassy and pyrolytic) **or composites with CNTs and graphene which can be structured by lithography**. Upon annealing, resin is converted into a conductive and inert material (glassy carbon) and this formed glassy carbon is both conducting and mechanically stable.

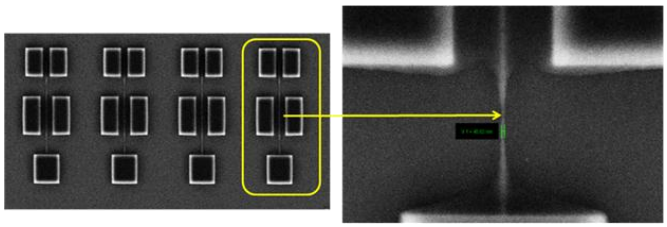


Schematic of glassy carbon NEMs device.

Advantages

Using this production method the whole device can be fabricated entirely from carbon by top-down processing. While silicon technology is very advanced, switches can suffer from low conductivity through the channel and poor mechanical behaviour. Carbon has a clear advantage here due to its higher conductivity and higher Young's modulus, combined with low weight. Additional advantages include:

- Ability to work at high temperatures, extreme conditions, and in hazardous environments including radiation
- Chemically inert
- Bio-compatible
- Cost effective



Example of a fabricated structure with a 50 nm (approx.) channel.

Applications

Carbon NEMS combine smaller mass with high conductivity, mechanical and chemical robustness and are therefore most interesting for applications such as:

- High frequency resonators
- Ultrasensitive sensors: chemical, biological, motion, acceleration
- Portable power generation (Energy harvesting)
- Imaging
- Transistors/switches
- Resonators for radio and microwave frequencies

Technology and patent status

A priority patent application was filed in late 2012.

The opportunity

This technology is available for license. We are also interested in working with a development partner.

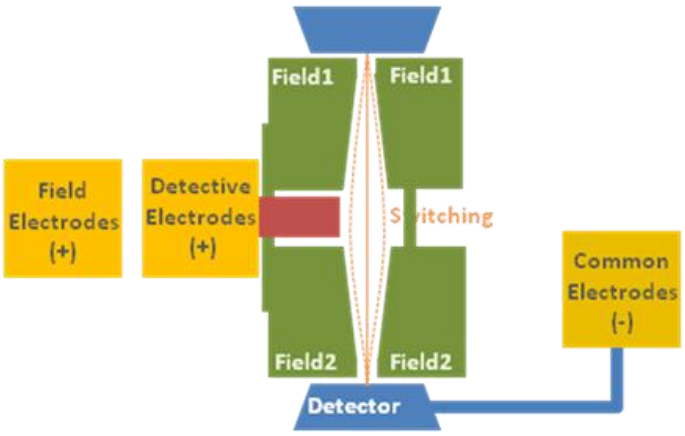


Illustration of side view of NEMS device.

Inventors: Prof. Georg Duesberg, School of Chemistry, Trinity College Dublin
Contact: Brendan Ring, CRANN Commercialisation Manager ✉ Brendan.Ring@tcd.ie
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