Energy Harvesting Circuits

Graphene-based Energy Harvesting
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Physical Review E Paper

From Patent
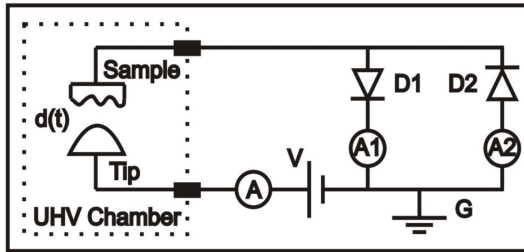
Setup

Figure: STM & Circuit Setup

STM Configuration

- ▶ STM in point-mode of operation : fixed (x, y)
- ▶ Constant Height Mode : fixed V_{STM} & fixed z
- ▶ Tunneling Current is measured.
- ▶ When the bias voltage (V_{STM}) is increased, the graphene approaches the STM tip, while, on the other hand, when the tunneling current is increased the graphene contracts from the STM tip.

Currents

▶ Two Diodes to isolate Displacement Current from Tunnelling Current
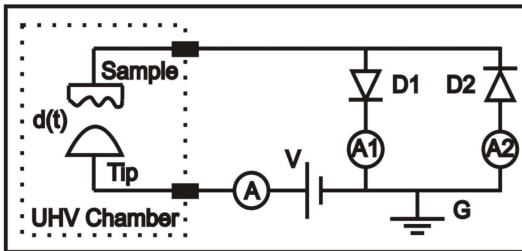
▶ To measure displacement current, STM tip is backed away from graphene until no electrons can tunnel through.
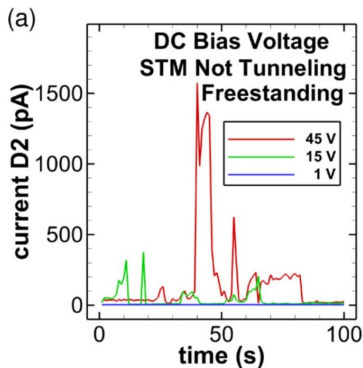
Measurements & Observations

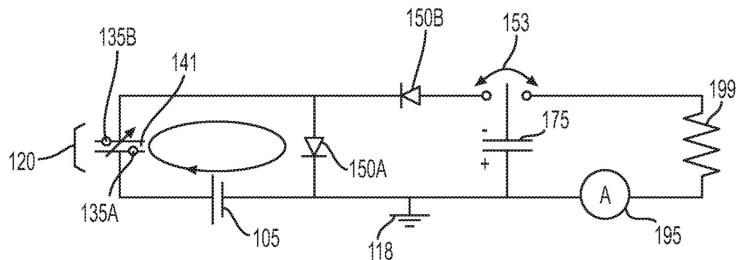Figure: Current through D2 at various Bias Voltages

Displacement Current

▶ Modelling Capacitance :

$$C_0(V) = \frac{\epsilon A(V)}{d} \; ; C(x) = \frac{C_0}{1 + \dfrac{x}{d}}$$

▶ Displacement Current, i_d

$$I_{\Delta C}(t) = \frac{\epsilon_0 A}{d_0^2} \Delta d(t) V_{STM} \times f$$

Circuit in Patent

$$Q_{ch}(t) = \frac{\epsilon_0 A f \langle \Delta d \rangle}{d_0^2} V_{stm} t + k G_{stm} \langle \Delta d \rangle I_{stm} t$$

Similar Mention to Electrets

to any one configuration for charge displacement. For example, in another embodiment, the membrane **265** is an insulating material that is impregnated with charged particles that are then unable to move along the membrane. In this case, the membrane vibration will induce a current to flow without needing a voltage source. As described below, this embodiment may be dominated by current tunneling from a proximate electrode or by variable capacitance induced by the fixed charge on the membrane (i.e., an internally polarized embodiment). Also, as in other embodi-