The ability to change shape is a compelling attraction of molecular semiconductors. Compared to rigid inorganic materials, molecules are soft and malleable, and their conformational changes are essential to the functionality of biological systems. Applications of nanoelectromechanical (NEM) molecular devices include memories and transistors. Information can be stored in the conformation of molecules, potentially leading to very high density memories, and molecular transistors that change shape under bias could exhibit subthreshold slopes of $<< 60$ mV/decade [1]. Indeed, as an example of the potential of NEMs, voltage-gated ion channels possess subthreshold slopes of approximately $15$ mV/decade [2].

Although many materials are available for NEM applications, carbon nanotubes exhibit low resistance and good mechanical properties. In this project, we are constructing a NEM testbed. The proposed design for our relay is shown in Figure 1. Nanotubes are directly grown at the bottom of an electron-beam defined trench etched in Si. This offers better control over the nanotubes and removes the need for additional steps that are required for the removal of surfactants and organics from the surface of the nanotubes. Because the nanotubes are vertically oriented, we are able to take advantage of the smallest size feature of the carbon nanotube: its diameter. This allows us to create dense arrays of relays for applications such as memory or logic devices. The vertical orientation allows NEM structures with very large aspect ratios. Theoretical results [3] have shown that increasing the aspect ratio of a carbon nanotube reduces the voltage needed to pull in the nanotube, thereby reducing the power requirement. Furthermore, because of the ability to easily functionalize the surface of nanotubes, we can functionalize the tube with charge to lower the pull-in voltage even further.

**Figure 1:** Schematic of the proposed device.

**Figure 2:** Actual device without nanotube.

**REFERENCES:**

