Abstract:
Our goal is to fabricate devices that will make possible the measurement of the high-frequency properties of carbon nanotubes. It has been predicted [1, 2] that carbon nanotubes should exhibit a resonant frequency that varies inversely with length and is in the range of hundreds of gigahertz for tubes a few microns long. This resonant frequency is important for two reasons. First, if it exists, it imposes design constraints on any nano-scale circuits that might include carbon nanotubes as either transistors or interconnects. Second, the frequency at which the resonance occurs is a probe of the interaction between electrons, which is different for one-dimensional systems such as nanotubes than for bulk materials with which we are familiar.

Because this frequency depends on the length of the nanotube and no technology currently exists to grow a large number of nanotubes of uniform length, it is necessary to study a single nanotube. The joint constraints of working in a very difficult-to-access frequency range and coupling radiation into a single nanotube require novel experimental methods to enable these measurements.

Summary:
We have designed bowtie antennas bridged by a carbon nanotube that can be used in a time-domain terahertz interferometer to couple radiation into the carbon nanotube. We have not yet been successful in fabricating an antenna in which a carbon nanotube bridges this gap between halves of the antenna. Fabrication is ongoing, and improvements to the method are in progress.

References:
Devices for Measuring the High-Frequency Electrical Properties of Carbon Nanotubes

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Figure 1:
In the fabrication of the devices, the first step is to create the small triangular catalyst pads and to grow nanotubes from them. Then an aluminum bowtie antenna is fabricated over them. The bowtie antenna has a very broadband response, so any features in the overall response will be due to the nanotube.

Figure 2:
The catalyst pads are clearly visible in the image of the bowtie antennas.

Figure 3:
Nanotubes are imaged using an atomic force microscope.