Technology Focus: Sensors

Hybrid Architecture Active Wavefront Sensing and Control

Goddard Space Flight Center, Greenbelt, Maryland

A method was developed for performing relatively high-speed wavefront sensing and control to overcome thermal instabilities in a segmented primary mirror telescope [e.g., James Webb Space Telescope (JWST) at L2], by using the onboard fine guidance sensor (FGS) to minimize expense and complexity. This FGS performs centroiding on a bright star to feed the information to the pointing and control system.

The proposed concept is to beam split the image of the guide star (or use a single defocused guide star image) to perform wavefront sensing using phase retrieval techniques. Using the fine guidance sensor star image for guiding and fine phasing eliminates the need for other, more complex ways of achieving very accurate sensing and control that is needed for UV-optical applications.

The phase retrieval occurs nearly constantly, so passive thermal stability over fourteen days is not required. Using the FGS as the sensor, one can feed segment update information to actuators on the primary mirror that can update the primary mirror segment fine phasing with this frequency. Because the thermal time constants of the primary mirror are very slow compared to this duration, the mirror will appear extremely stable during observations (to the level of accuracy of the sensing and control). The sensing can use the same phase retrieval techniques as the JWST by employing an additional beam splitter, and having each channel go through a weak lens (one positive and one negative). The channels can use common or separate detectors. Phase retrieval can be performed onboard. The actuation scheme would include a coarse stage able to achieve initial alignment of several millimeters of range (similar to JWST and can use a JWST heritage sensing approach in the science camera) and a fine stage capable of continual updates.

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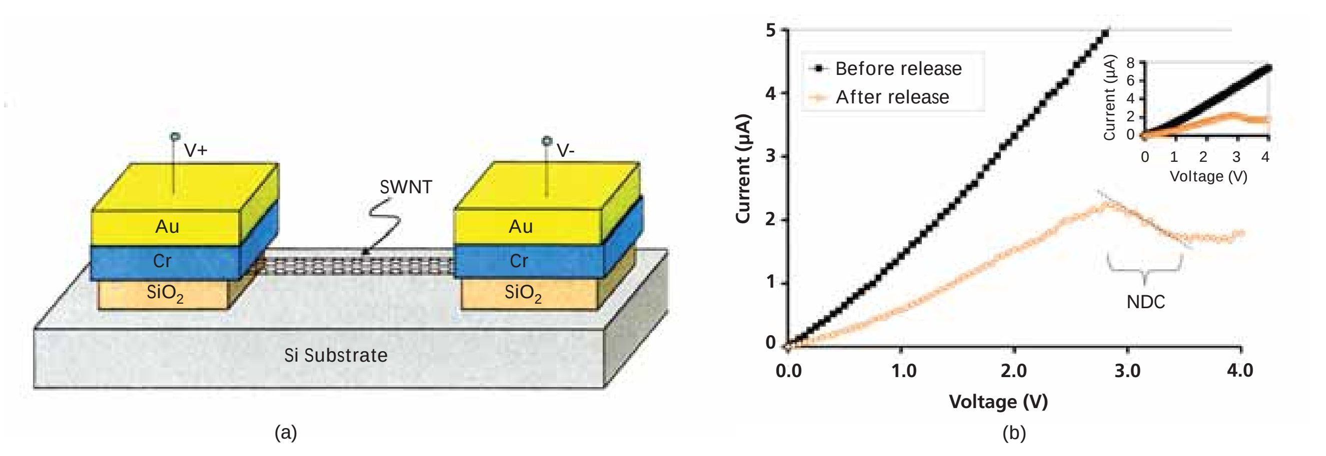
Carbon-Nanotube-Based Chemical Gas Sensor

This sensor has applications in leak detectors for the automobile, electronics, and medical industries.

NASA's Jet Propulsion Laboratory, Pasadena, California

Conventional thermal conductivity gauges (e.g. Pirani gauges) lend themselves to applications such as leak detectors, or in gas chromatographs for identifying various gas species. However, these conventional gauges are physically large, operate at high power, and have a slow response time.

A single-walled carbon-nanotube (SWNT)-based chemical sensing gauge relies on differences in thermal conductance of the respective gases surrounding the CNT as it is voltage-biased, as a means for chemical identification. Such a sensor provides benefits of significantly reduced size and compactness, fast response time, low-power operation, and inexpensive manufacturing since it can be batch-fabricated using Si integrated-circuit (IC) process technology.



A schematic (a) of the **CNT Gas Pressure or Chemical Sensor**. Au/Cr electrodes anchor the tube during exposure to 10:1 BHF for removing SiO_2 beneath the tubes. Critical point drying in an IPA bath is used for the final release. (b) The comparison of conductance for an unsuspended and suspended tube. The suspended tube shows a negative differential conductance (NDC) regime. The inset shows the current is still linear up to a current as large as 8 µA for the unsuspended tube.