Scientists develop new terahertz material

March 15 2007

Researchers at Los Alamos National Laboratory have created a device for manipulating terahertz (THz) radiation. The device could be the basis for novel electronics and photonics applications ranging from new imaging methods to advanced communication technologies. The THz range of the electromagnetic spectrum lies between the infrared and microwave wavelengths.

In research published in the journal *Nature*, Los Alamos scientist Hou-Tong Chen and his colleagues explain how metamaterials (artificial materials with properties derived from their sub-wavelength structures instead of their compositions) can be designed to efficiently control THz waves.

According to Chen, "devices that generate and detect THz radiation are already in development, but techniques to actually control the waves are lagging behind. This is the next logical step in the development of terahertz technologies for wider electronics and photonics applications."

Like microwaves, terahertz radiation has the ability to penetrate a wide variety of non-conducting materials like paper, plastics, wood, and ceramics. Because it can "see" through plastics and cardboard, it might also be used in manufacturing to inspect packaged objects for quality control or process monitoring. THz radiation is sensitive to the water content, which means it might be used to detect differences in body tissue density. Because terahertz radiation is non-ionizing, it does not damage DNA like X-rays and might someday be used as a safer alternative for certain types of medical and dental imaging. Non-ionizing

means the radiation does not have enough energy to convert electrically neutral atoms into ions by knocking an atom's electron from its orbit.

To create their device, Chen and his colleagues used micro-fabrication processes to lay down an array of gold metamaterial structures over a semiconductor substrate. An applied voltage between the substrate and the metamaterial enables the device to modulate the intensity of THz waves by up to 50 percent. The experimental demonstration of the device exceeds the performance of existing electrical THz modulators and the team hopes to further improve the device's performance in coming months.

In addition to Chen, other members of the THz device development team include Willie Padilla, formerly of Los Alamos and now with Boston College, Richard Averitt, formerly of Los Alamos and now with Boston University, Antoinette Taylor from Los Alamos, and Joshua Zide and Arthur Gossard from the University of California, Santa Barbara. The research was supported by Laboratory Directed Research and Development funds and the Center for Integrated Nanotechnologies, a DOE/Office of Science Nanoscale Research Center.

Source: Los Alamos National Laboratory