Terawatt Laser Pulses Generate Collimated Beams of Fast Protons from Thin Foil Targets

Most of the recent research into the interaction of pulsed laser beams with matter (solids, gas jets, and clusters) has focused on the generation of compact neutron sources. Now a team of researchers from the University of Michigan and Osaka University are reporting the production of a collimated beam of fast protons with energies as high as 1.5 MeV when a high-intensity, high-contrast subpicosecond laser is focused onto a thin foil target. This development could prove significant for the initiation of small-scale nuclear reactions in the laboratory.

As reported in the May 1 issue of *Physical Review Letters*, the experimenters used a 10 TW hybrid Ti:sapphire/Nd:phosphate glass CPA laser capable of delivering up to 4 J in a 400 fs pulse at a wavelength of 1.053 μm. The laser pulses were frequency doubled to generate 1 J pulses of green light and then focused to obtain intensities of 3×10^{18} W/cm^2 incident on thin foil targets. When this laser was focused on a thin film of aluminum with a thickness of 1.8 μm at angles of incidence ranging from 0° to 45°, a collimated beam of fast protons emerged in a direction normal to the back of the foil in a confined cone angle of 40 ± 10°. The number of protons generated was of the order of magnitude 10^9.

To pinpoint the depth of proton generation in the foil, reaction studies involving deuterons and the boron isotope ^{10}B were performed. With the isotope placed 1 cm behind the foil target, a thin layer of deuterated plastic was placed alternately on the front or back of the foil. The carbon isotope ^{11}C was detected in the boron sample when the deuterated film was placed on the front of the foil and laser pulsing was performed; no ^{11}C was detected when it was affixed to the back. This confirms that the ions are being accelerated from the front side of the thin foil. The researchers attribute the source of the protons to a thin layer of hydrocarbon and/or water vapor contaminants on the front of the foil. The proposed mechanism is charge separation due to hot-electron generation by the "vacuum heating" effect.

TIM PALUCKA

Improved Electronic Nose Developed for Highly Sensitive Detection and Discrimination of Biogenic Amines

A team of researchers from California Institute of Technology, Division of Chemistry and Chemical Engineering has developed an "electronic nose" that is highly sensitive to biogenic amines. Biogenic amines have been related to, among other things, freshness of foods, biomarkers for lung cancer, and breath odor in patients with renal failure. The researchers report the development of an electronic nose for biogenic amines that is a million-fold improvement over previous such devices and which significantly outperforms the human nose. Although the researchers have previously reported the construction of such a device consisting of an array of chemically sensitive resistors based on a mixture of carbon black and an insulating organic polymer (whose sensitivity exhibits trends generally close to the human nose for vapors of alkanes, alcohols, esters, carboxylic acids, and ketones), its thresholds for sensitivity to biogenic amines such as putrescine, cadaverine, and spermine are far away from those of its human competitor. For the new device, as reported in the March issue of *Chemistry of Materials*, the team has exploited the possibility of amines interacting with, and manipulating chemically, the electrical properties of a conducting organic polymer used in a composite material. Using the conductive polyaniline (referred to as

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