Tabletop Laser Offers Alternative to Cyclotron

Researchers at the University of Michigan in Ann Arbor and Osaka University in Japan have reported the development of a tabletop laser-based proton accelerator that could replace expensive cyclotrons in cancer treatment and lead to better health care.

A 10-TW, hybrid Ti:sapphire/Nd:phosphate chirped-pulse amplification laser targets thin films of aluminum with a 400-fs pulse at 1053 nm. Protons with energies of up to 1.5 MeV emerge in a tight cone behind the target.

Donald Unstadter, leader of the team, noted that most hospitals cannot afford a $15 million cyclotron, the conventional source of protons for the stereotactic radiotherapy of cancers. He said an inexpensive accelerator also could be used for the on-site preparation of short-lived radioisotope tracers.

Tunable Laser Devised for UV Resonance Raman Spectroscopy

Researchers from Princeton University in New Jersey and Chalmers University of Technology in Gothenburg, Sweden, have developed a solid-state kilohertz laser tunable from 205 to 230 nm. The instrument, described in Vol. 53, No. 10 of Applied Spectroscopy, promises to be a suitable laser source for time-resolved UV resonance Raman spectroscopy.

The setup comprises a frequency-quadrupled Ti:sapphire laser pumped by the second harmonic of a Q-switched Nd:YLF. The system produces >60 mW in the 210- to 230-nm range at 1 kHz, 4 mW at 205 nm and 16 mW at 206.5 nm.

The researchers have collected spectra of hemoglobin and the excitation profiles of aromatic acids, and they have selectively probed protein bands by tuning the laser's wavelength.

Online Mass Spectroscopy Method Makes Moves to IR

Two designs are leading to online, IR matrix-assisted laser desorption/ionization mass spectroscopy of biomolecules. Kermit K. Murray, an assistant professor of chemistry at Emory University in Atlanta, and colleagues from Odense University in Denmark added a rotating ball inlet to a UV matrix-assisted laser desorption/ionization mass spectrometer, eliminating the clogging associated with an earlier, frit-based online technique.

Murray has developed an IR system, but its 3-µm Nd:YAG-pumped optical parametric oscillator from Continuum of Santa Clara, Calif., suffered damage to a KTP crystal before the demonstration of the ball inlet. He said the researchers plan to investigate the use of ice as a matrix in an infrared system with the new inlet design. The IR version of this technique offers better ablation of a sample and the choice of more liquid matrices.

Optical Sensor Monitors pH

A team at Kyushu University in Fukuoka, Japan, says its laser-based pH sensor will be at least as sensitive as a fluorometric device. The sensor, reported in Analytical Chemistry, comprises a gel grating of the pH-sensitive thymolphthalein, which is transparent at pH <9.3 and blue at pH >10.5, and a 2-mW, 633-nm HeNe laser light source. A photodiode and digital oscilloscope measure the diffracted beam's intensity, and a digital camera records the diffraction pattern, which changes in response to alkalinity.

Infrared Spectromicroscopy Technology Identifies Bacteria That Eat Toxic Waste

Chemical and biological mechanisms had been suggested to explain the transformation of hexavalent chromium, a toxic industrial discharge, into a less dangerous trivalent form. Now scientists at the Lawrence Berkeley National Laboratory in Berkeley, Calif., have used Fourier transform IR spectromicroscopy to identify the reduction agent as Arthrobacter oxydans. This bacterium, which inhabits basalt, could help clean waste sites.

The lab's Advanced Light Source provided the light for the study, which monitored hexavalent chromium in the presence and absence of the bacteria. The researchers noted that the synchrotron's light is 200 times brighter at a 10-µm resolution than conventional sources, allowing them to examine the samples at low concentrations and in real time.