Laser Focus World

WASHINGTON REPORT

ARPA seeks cheaper, better laser weapons

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The geopolitical and budgetary changes that have reshaped the Department of Defense (DoD) are affecting the Pentagon's Advanced Research Projects Agency (ARPA) and the laser research it sponsors. Money is increasingly tight at the Pentagon, and ARPA—the DoD's technological hothouse—is focusing on laser programs that could result in weapons systems that cost less and do more for US troops.

Any civilian products would be a welcome by-product—but they are not the primary goal of ARPA projects, says L. N. Durvasula, program manager in ARPA's defense sciences office. "Defense is our number-one priority," he says. "Our goal is to bring new technologies and new manufacturing ideas into the marketplace, to make systems more affordable."

In particular, ARPA is seeking to develop technologies that will produce lasers with higher efficiency and performance, at lower cost, in devices that take up less space and weight. "They have to be compact and efficient," Durvasula says. "The bottom line is producing more coherent photons per [cubic centimeter] of volume per dollar." Thus, ARPA is funding research into lasers and related technologies that US industry eventually could take advantage of. Examples include development of high-power lasers such as Er:YAG, Cr:$LiSrAlF_6$, and Tm:YAG lasers and sophisticated nonlinear crystals such as $AgGaSe_2$, $ZnGeP_2$, BaY_2F_8, and $NaYF_4$ for use in wavelength conversion.

One of the ways ARPA is trying to shape and guide industry's capabilities is its requirement for new diode-pumped solid-state lasers for defense applications such as laser countermeasure weapons and for lidars for producing images of the battlefield. Lasers are needed for the full spectrum—from the ultraviolet to the visible to the mid-infrared and even longer infrared wavelengths, Durvasula says.

But those solid-state lasers in turn require laser diodes for pumping, and the Pentagon's tight budgets mandate diodes that are 10 to 100 times cheaper than those currently available. "We need to bring about dramatic improvements," Durvasula says. Inexpensive diodes also are needed for a variety of other applications, such as displays and telecommunications, he says.

Thus, ARPA is trying to develop the technological basis for mass production of high-power but inexpensive laser diodes. For example, ARPA-sponsored research at Northwestern University (Chicago, IL) is focusing on technology for aluminum-free diodes emitting at 808 nm for use in pumping Nd:YAG lasers.

Specifically, the research, being conducted by Manijeh Razeghi at the university's Center for Quantum Devices, seeks to demonstrate the use of a metal-organic chemical-vapor deposition (MOCVD) process to produce laser diodes of indium gallium arsenide phosphide (InGaAsP) as a replacement for diodes based on AlGaAs.

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> *L. N. Durvasula*

InGaAsP diodes can handle high power levels without suffering optical damage and can operate 100 times longer than gallium arsenide diodes—10 million hours—without failing. But manufacturing InGaAsP diodes has been time-consuming and expensive. Fabrication of InGaAsP diodes by commonly used liquid-phase epitaxy may not be practical for mass production.

Already, Razeghi and his colleagues have shown promising results with their MOCVD process. For example, diodes produced with the process have operated at high power for 1000 hours at room temperature. If MOCVD proves to be feasible and effective for manufacturing 808-nm diodes, Durvasula suggests the process might be adapted easily to make diodes that emit—and thus pump solid-state lasers—at many other wavelengths from 670 to 2000 nm.

ARPA itself will not get into the business of manufacturing the diodes, Durvasula emphasizes. Rather, the agency will make its research results available to current diode manufacturers, who could perfect and adapt the MOCVD process for industrial use. "We would expect the cost to come down through competition," Durvasula says. "Our goal is to bring new technologies and new manufacturing ideas into the marketplace to make systems affordable."

Technology Reinvestment Program

Meanwhile, ARPA also is girding itself for two new rounds of industry proposals and contract awards in the Technology Reinvestment Program (TRP), the Clinton administration's interagency effort to turn defense technology to civilian use. The first 1994 round, for which proposals were due June 30, is narrowly focused on fields that, in the view of government managers, received too few high-quality proposals in the 1993 TRP competition—high-density data-storage systems; testbeds for assessing the interoperability of technologies in the planned national information infrastructure; manufacturing process technology for high-definition displays; portable environmental sensors; and low-cost electronic packaging. This round also will include funds for manufacturing extension centers that will advise small- and medium-sized defense companies on manufacturing technology and employee training that would boost the companies' competitiveness.

The second round of 1994 TRP awards will be much more like the 1993 awards, with a much wider range of Technology Focus Areas for which companies could seek government funds. ARPA plans to announce those areas and application dates later this year. For information call (800) DUAL-USE or e-mail: pa94-27@arpa.mil. □

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