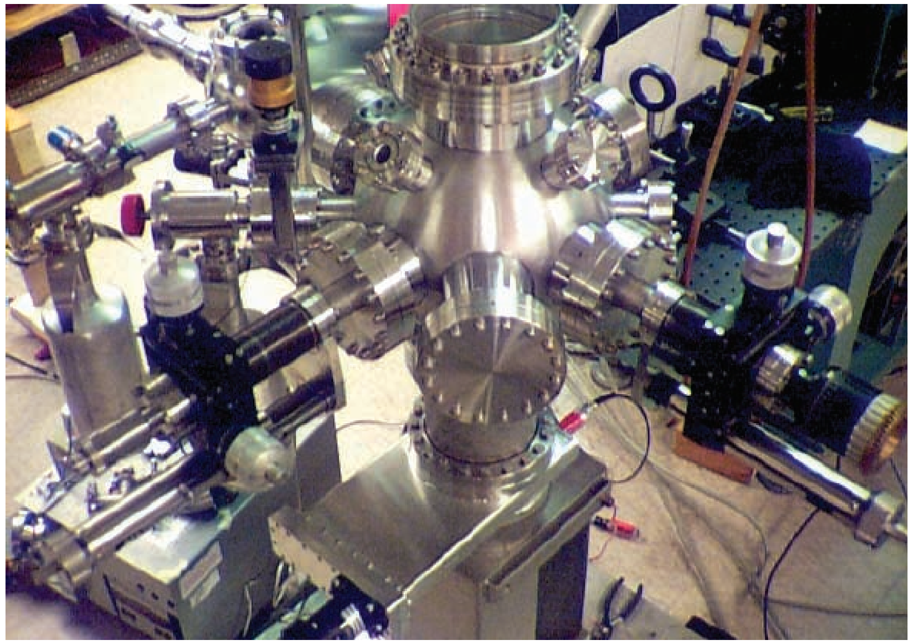
Scatterings

TYLER KRUPA

Stationary Light Created Within Nanostructures



University of Michigan College of Engineering.

Ultrahigh vacuum chamber used by the University of Michigan team to observe lasing.

Researchers at the University of Michigan College of Engineering, led by Stephen Rand and Richard Laine, have recently generated stationary light within a random medium that oscillates in time but does not move through space. The results mark the first experimental verification that non-propagating light can produce laser action in strongly scattering media, using the strong localization effect predicted in the 1950s for electron waves by Phil W. Anderson.

"Other research groups have done similar things with coherent control techniques to slow down or stop light," said Rand, a professor of applied physics. "However, this is the first method in which light is generated as a stationary excitation from the very beginning."

The research team achieved this result by first synthesizing nanopowders with an inexpensive flame spray pyrolysis technique. Light generated by rare earth atoms using electron excitation of nanoparticles as small as a fiftieth of the optical wavelength was shown to remain within a wavelength of its point of origin by being repeatedly bounced back and forth between the densely packed, reflective particles. This created a nano-sized "hall of mirrors" that provided feedback and amplification of light. Lasing was observed in an ultrahigh vacuum chamber as the result of trapped light "leaking" from regions near the powder surface. The laser output was both incoherent and omnidirectional.

Using this method, the research team demonstrated the first continuous-wave (cw) random laser in which the light experienced feedback characteristic of a cavity even though no physical cavity was apparent. According to Rand, this is the first random laser to exhibit the optical properties expected of a strongly localized light source in which electromagnetic transport is completely absent.

"This is exciting for all phosphor-based lighting applications because the introduction of laser phosphors removes the fundamental limitations on the brightness imposed by spontaneous emission rates," said Rand.

The technology, which is being commercialized by TAL Materials (Ann Arbor, Michigan), will be used to create improved fluorescent lights, advanced televisions, and flat panel displays.