Fraunhofer USA

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Developments

Fraunhofer USA, Inc.
Research Centers:

Center for
Coatings and Laser
Applications (CCL)

Center for
Experimental Software
Engineering, Maryland (CESE)

Center for
Laser Technology (CLT)

Center for
Manufacturing Innovation (CMI)

Center for
Molecular Biotechnology (CMB)

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"Antibodies Produced in Plants"

Dr. Vadim Mett, Principal Investigator of Fraunhofer CMB, and pictured above in his garden, leads this important project. Dr. Mett and his colleagues recently published a scientific paper in the journal Vaccine describing their results.

Dr. Vadim Mett is using plants to produce antibodies. These antibodies have the potential to be used as treatments against major infectious diseases and agents of bioterrorism, such as anthrax. For example, his research on making anthrax antibodies in plants, is aimed at providing a therapeutic that could be used by exposed individuals following release of anthrax spores. The antibodies should provide protection for about two weeks, more than enough in an emergency situation.

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Dr. Mett with his Research Assistant Carolyn Reifsnyder

Dr. Mett and his colleagues at Fraunhofer CMB are growing non-transgenic plants and infecting them with engineered plant viral vectors so that they produce antibodies. "We made all the necessary genetic manipulations, put the vector's coding for antibodies against anthrax proteins into plants, harvested plant tissues making the antibodies and purified the antibodies by extracting proteins from plant tissue and separating out the antibodies using a chromatography based system. These plant-produced antibodies provide 100% protection against lethal challenge", said Dr. Mett.

Following an outbreak, any potentially-exposed individual may require treatment, and antibodies are a very good option for providing this. The panic that can be caused by a potential anthrax release was evidenced a few years ago when "anthrax letters" were sent to unsuspecting people, including a U.S. Senator.

The entire technology platform at CMB is based on plants. They grow very quickly and at a lower cost than competing production systems. Three days after the introduction of vector sequences, the plants are ready for testing. What accounts for the speed is the nature of the technology and the talents of Dr. Mett and his team. Also, plants don't contain any known human pathogens and are thus considered to be a safe production platform.

The plants can even be grown safely in an industrial greenhouse. In the case of the antibodies described above, the plants produce the desired protein in three days, at which point they are cut and put in a blender and pulverized. The debris is filtered out and the remaining extract is passed through a chromatography system, where a column contains a medium that selectively binds the antibodies.

Fraunhofer CMB addressed the issue of protection against anthrax along with other biothreats at last year's meeting "*Innovations in Mitigating BioThreats*" held in Wilmington, Delaware. The objective of the meeting was to bring experts from academia, industry and government together to understand and combat sudden outbreaks of disease, natural or man-made.

Dr. Mett's background in Biology, Virology and Molecular Biology started in the late 1970's at Moscow State University. He received his Ph.D. at the Institute of Molecular Biology, Academy of Sciences in Moscow. His work took him to New Zealand where he worked in the Horticulture and Food Research Institute. In 2000, he became an Assistant Professor at Thomas Jefferson University where he again had the opportunity to work with his old colleague Dr. Vidadi Yusibov. In 2001, Dr. Yusibov was hired to be the Scientific Director at the new Fraunhofer CMB, and it was at this time that Dr. Mett was invited to join the center as the Principal Investigator.

In his leisure time, Dr. Mett enjoys gardening at home.

CMI's David Chargin Leads Project *"Scanning Beam Interference Lithography System to Pattern Diffraction Gratings"*

David Chargin is leading a project called "Scanning Beam Interference Lithography to Pattern Diffraction Gratings" at the Fraunhofer Center for Manufacturing Innovation. Interference lithography is a process which uses two coherent laser beams to generate an interference pattern of parallel, straight lines which exposes a photoresist. Large exposure areas require large, expensive lenses and are subject to optical distortion, making the pattern less accurate. Diffraction gratings are optical elements with many parallel straight lines that reflect or transmit light in different directions depending on wavelength. Big diffraction gratings are used in the optical systems of large laser beams which are needed for fusion energy reactions. The gratings used for fusion energy are nearly a meter in length by half meter in width. One of the ways in which fusion can be created is by "inertial confinement" where a tiny pellet of frozen hydrogen is compressed and then heated with intense energy such as a laser beam. This process has to be performed quickly so that fusion occurs before the atoms can fly apart.

Fraunhofer CMI was contracted by Plymouth Grating Laboratory to build a machine for creating very accurate, large scale gratings to supply the fusion energy industry. These gratings have a series of etched, very straight lines in glass that are only 200 nanometers in width and straight to nanometer scale tolerances. CMI has created a system which writes the very straight lines by scanning an interference pattern of two UV laser beams over the optical substrate. This patterns the lines in a photoresist, a plastic polymer on top of the glass. This is followed later by a process which chemically etches through the resist pattern, leaving behind "hills and valleys" in the surface of the glass.

CMI works on a tiny area of substrate which is scanned and exposed. A high speed measurement system optically steers the interference pattern to correct for errors in the mechanical motion of the scan to ensure accuracy. It is capable of shifting the position of exposure every 100 microseconds. A very high bandwidth control loop makes this happen. As only a small exposure area is needed, optical distortion from lenses is minimized.

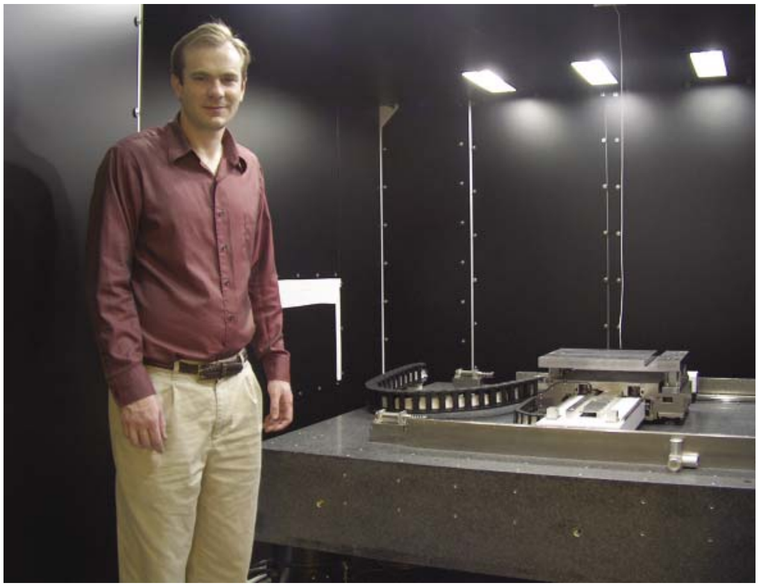
The big lasers for fusion energy reactions cost from hundreds of millions to several billion dollars to build. The Livermore lab had to construct an entire building around the laser. The federal government's 2006 appropriation for Fusion Energy Science (FES) is $287,644,000. According to the FY 2007 Congressional Budget, "The FES program is the national research effort to advance science, fusion science and fusion technology – the knowledge base needed for an economically and environmentally attractive fusion energy source. Fusion could play a key role in U.S. long-term energy plans and independence because it offers the potential for plentiful, safe and environmentally benign energy."

Chargin leads this important project which consists of three of his CMI colleagues; two people from Plymouth Grating, three engineers from Bauer who perform the optical design, and two people from the Massachusetts Institute of Technology (MIT) who helped pioneer this technology.

Future applications include: encoders for positioning of machines, semi-conductors, 3D displays and televisions.

Chargin received his Master's Degree from MIT and was hired by Fraunhofer CMI in mid-1999.

In Chargin's leisure time, he enjoys traveling throughout the U.S., Europe, and Asia. He also enjoys boating and working on his 1985 Toyota Supra.



Notes from Headquarters

Walking down the hallways in any of Fraunhofer's locations, you can hear discussions of how Fraunhofer USA's technologies are being utilized in a wide variety of industries. Many of the world's largest companies have found Fraunhofer to be a resourceful partner in exploring ways to streamline their factory applications, create prototypes, optics or vaccines, grow plants or crystals, evaluate machine designs or software, develop processing techniques or assist in achieving certification. Fraunhofer's expertise and technologies can be found in the automotive and aircraft sectors, railroad and shipping industries, aerospace and medical fields, as well as some of the major departments of government such as energy, and homeland security. Fraunhofer's laser welding and coatings are found in medical implants, in oil exploration, in shipbuilding, plumbing, recreational sport vehicles, and defense operations. Fraunhofer's software experts evaluates and assists universities, industry and governmental agencies. Fraunhofer's scientists develop plant-based biological products for control and prevention of infectious diseases.

Fraunhofer's laser team produced a "turn-key system" in which a laser system was designed and built for a customer who wanted to offer an innovative product to the automotive market. The system produced up to 1 million parts per year. Their team also welds glass, plastic, metal and non-metal materials together.

The scientists and engineers at Fraunhofer CMI work with clients to develop new manufacturing processes where none exist. They review product designs, generate product specifications, provide design alternatives and manufacturability assessments.

Fraunhofer partners with major universities and research institutes in both the U.S. as well as in Germany. Through these collaborations, scientific exploration and industry production is enhanced, jobs are created, and society benefits.

To see how Fraunhofer can help your organization, please contact any of the following:

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