PROPULSION DIRECTORATE

Monthly Accomplishment Report
June 2004

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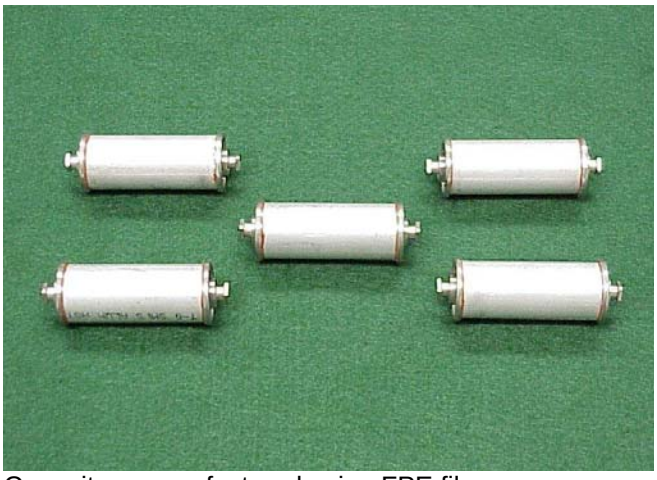
MILESTONE REACHED IN PRODUCTION OF CAPACITOR FILM: AFRL/PR achieved a significant milestone in the production of fluorene polyester (FPE) dielectric film. Under Propulsion Directorate sponsorships, Brady World Wide Coatings successfully produced 2.35 µm FPE material in quantity, achieving an AFRL milestone goal to successfully manufacture thinner gauge film for use in power conditioning applications. Brady will now manufacture large rolls of the material for device fabrication and testing. The FPE dielectric exceeds the electrical and thermal performance of the widely used high temperature (125°C) polycarbonate dielectric material. FPE is critical to maintaining a defense industrial base in robust capacitors since the previous state-of-the-art capacitor technology, polycarbonate dielectric, is no longer available. (Ms. S. Fries-Carr, AFRL/PRPE, (937) 255-4101)



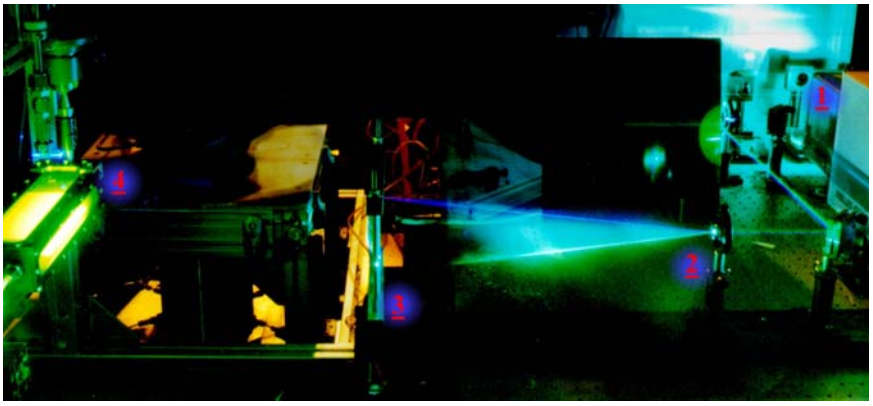
Capacitors manufactured using FPE film

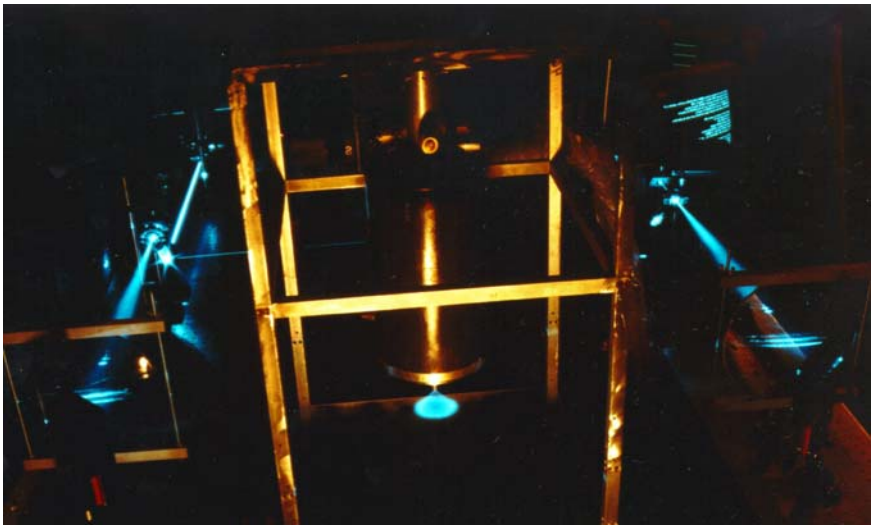
IPD TECHNICAL STAFF WINS NASA AWARD: The NASA Space Launch Initiative (SLI) Office of Aerospace Technology (Code R) recently selected the Integrated Powerhead Demonstration (IPD) Technical Staff for the NASA Turning Goals into Reality Award. The IPD team was selected for this award. The members of the winning team include PR's Messrs. Stephen Hanna, Tri Nguyen, and Jeff Thornburg, as well as personnel from NASA Stennis Space Center, NASA Marshall Space Flight Center, Boeing-Rocketdyne Propulsion and Power, and GenCorp Aerojet. This award recognizes the IPD technical staff for achieving component test goals in an extremely exemplary, efficient, and effective manner. The IPD Program was initiated in 1994 to address the significant cost and schedule drivers of the Space Shuttle Main Engine, and it addressed the DoD/NASA need to operate a highly reliable and long-life rocket engine system with significantly reduced operating costs. IPD Program successes are unsurpassed in the past 30 years of rocket engine development, and IPD is poised to provide component and engine technologies that will be critical to the success of future boost

Mr. Jeff Thornburg was one of the three AFRL/PR members that received the NASA Turning Goals into Reality Award

and upper stage engine development. The Turning Goals into Reality Award was presented at a ceremony at NASA Headquarters in Washington DC on 14 July 2004. (Mr. S. Hanna, AFRL/PRSE, (661) 275-6021)

AFRL/PR PATENT OFFERS IMPROVED METHOD TO CHARACTERIZE SPRAYS: US Patent #6,734,965, "Optical Patternation Method," was issued to Dr. Douglas G. Talley of the Propulsion Directorate and Drs. Vincent G. McDonell and G. Scott Samuelsen of the University of California at Irvine on 11 May 2004. "Patternation," as described in this invention, refers to the measurement of specific properties of particles (e.g., surface area and/or mass distributions) within a particle field such as a spray. The efficacy of the sprays in most applications depends largely on the spatial distribution of the particles (i.e., droplets of liquid) or its "pattern" produced by an atomizer. Consequently, a method capable of quickly and reliably characterizing this pattern has been sought for many years. This invention describes an optical technique to characterize this pattern. Applications for this technique abound, but one application of particular interest is the characterization of fuel injection for gas turbine and rocket engines. However, this technique is also relevant to such widely varying applications as water sprinklers, paint sprayers, medicinal coatings for tablets and pills, aerosols for inhalation therapy, and countless others. This method could also be used for quality control in the production of atomizers. (Dr. D. Talley, AFRL/PRSA, (661) 275-6174)





A recent patent described a method to quickly and reliably characterize the pattern of sprays emitted from devices such as fuel injectors

DR. FORSTER NAMED AFRL FELLOW: The Propulsion Directorate's Dr. Nelson H. Forster was among the six individuals named as new AFRL Fellows for 2004. Dr. Forster is the DoD's top expert for mechanical systems (i.e., gears, bearings, and lubrication) in technology demonstrator, development, and production turbine engines. He serves as the Principal Investigator for the Air Force in-house research program in mechanical systems for gas turbine

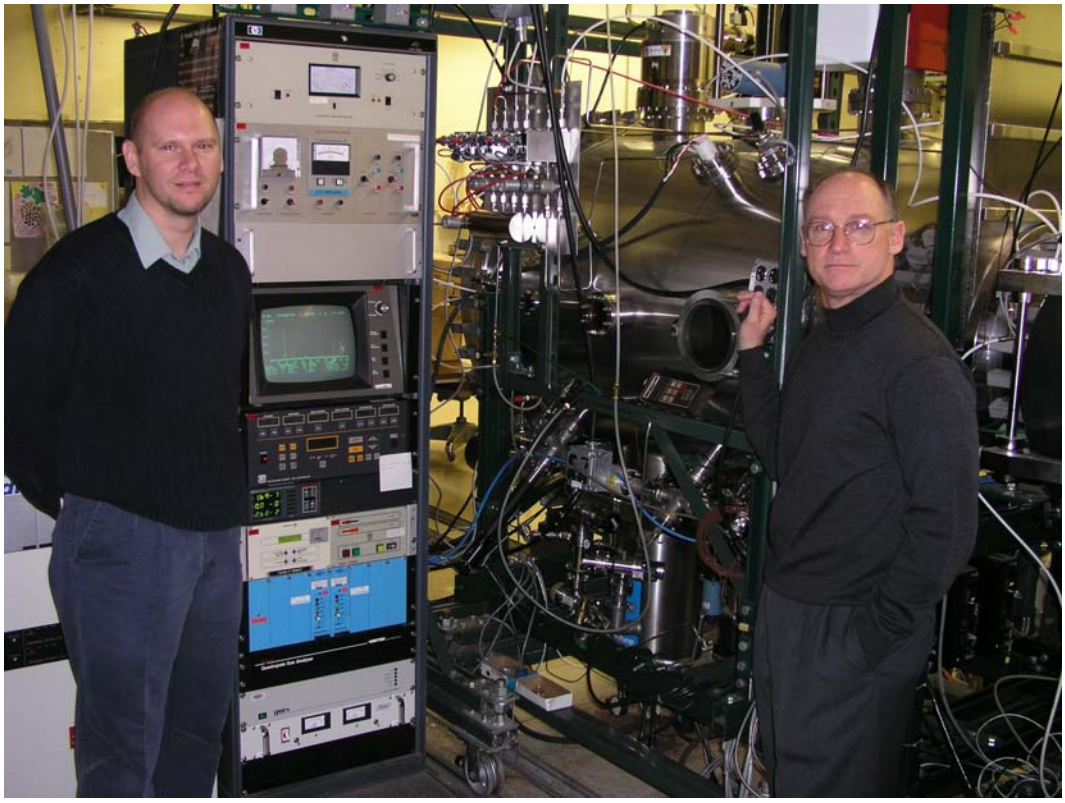
Dr. Nelson H. Forster was selected as a new AFRL Fellow for 2004

engines, leading a team of ten scientists/engineers and three technicians. He is also held in high regard throughout the technical community, and his advice is routinely sought with regard to mechanical systems design and material selection for advanced gas turbine engines. Dr. Forster is a Fellow of the Society of Tribologists and Lubrication Engineers (STLE), and he has received the Captain Alfred E. Hunt Award (twice) and the Edmond E. Bisson Award from STLE for his outstanding publications. He is also the holder of six patents (with one additional patent pending), covering a wide range of high temperature lubrication concepts, composite bearing cages, and revolutionary mechanical systems. He will be recognized along with the other new AFRL Fellows at a banquet to be held on 29 September 2004 at Wright-Patterson AFB, Ohio. (Dr. R. Wright, AFRL/PRTM, (937) 255-5568)

PR FOSTERS OPPORTUNITIES FOR HIGHER EDUCATION: The Propulsion Directorate's Dr. Jeigh Shelley was recently detailed to the new Lancaster University Center, Lancaster, California, as a mechanical engineering professor. This center is a part of a new initiative to team with the California State University-Fresno and the California State University-Bakersfield through an Education Partnership Agreement. The two universities will be offering engineering coursework at the Lancaster campus starting this fall. This arrangement strives to increase the technical base of the local community by bringing a 4-year university to the Antelope Valley. Dr. Shelley's wealth of solid and liquid rocket propulsion expertise will effectively help to grow a local pool of researchers from which AFRL can draw. This is another significant stride in Edwards Research Site's educational outreach program, which conducts various activities, such as science fair judging; student and teacher oriented math, science, and chemistry programs; science teacher in-service education sessions; special lab tours; and career programs. (Mr. E. Koppisch, AFRL/PRSE, (661) 275-5198)

ADVANCED HIGH TEMPERATURE DIELECTRICS DEVELOPED: The Propulsion Directorate is collaborating with Innovative Scientific Solutions, Inc. (ISSI), and Ohio University to produce amorphous carbon nitride (CN_x) films. These films could serve as advanced high temperature dielectrics in the next generation of high temperature, high power capacitors. CN_x films are predicted to be harder than diamond and are expected to provide other characteristics similar to diamond, such as high thermal conductivity, thermal stability at high operating temperatures, high electrical resistivity, and high electrical breakdown strength. These

films are expected to have operating temperatures between 400-600ºC (752-1112ºF). In comparison, current standard technology is rated up to 125ºC and current advanced technologies such as FPE* and DLC† are rated up to 250ºC. The high breakdown strength predicted for these materials will provide increased energy storage when compared with current equivalent sized components, or the same energy storage of today's components in a lighter and smaller package. The ability to withstand higher temperatures while storing greater amounts of energy will allow advanced systems to place electrical components closer to the point-of-use and will allow these components to replace heavy mechanical systems currently being used. This technology is needed for future applications such as the More Electric Aircraft (MEA), more portable electrical-accelerator systems, and for applications that will benefit from more reliable components with greater durability and mean-lifetime-before-failure (MTBF). Films currently being produced are showing good thermal stability (up to 600°C), but breakdown strengths have been low. Work is continuing on improving the film characteristics. (Dr. C. DeJoseph, AFRL/PRPE, (937) 255-2923)



Mr. William Lanter of ISSI (L) and Dr. Charles DeJoseph of AFRL/PR (R) are working to develop CN_x films for the next generation of high temperature, high power capacitors

MR. LEWIS RECEIVES PRESTIGIOUS CIVILIAN AWARD: The Propulsion Directorate's Mr. Timothy J. Lewis recently received the Meritorious Civilian Service Award. This award recognizes Mr. Lewis for his contributions to the development and transition of advanced turbine engine control systems technology, and for his leadership of analytical studies that were

* FPE = Fluorene Polyester
† DLC = Diamond-Like Carbon

instrumental in launching the Versatile Affordable Advanced Turbine Engines (VAATE) Program. Mr. Lewis took leadership of PR's Engine Controls and Accessories Group in 1994 and assumed responsibility for defining the plans and programs required to meet the goals of the Integrated High Performance Turbine Engine Technology (IHPTET) Program. In this role, he became an internationally recognized expert in engine control technology, and he exemplified professionalism as he represented AFRL in numerous national-level endeavors. In 2000, Mr. Lewis took on a new assignment as leader of the Assessment Group as part of a major reorganization of the Engine Integration and Assessment Branch (AFRL/PRTA). He led in-house analyses to define baseline and advanced engine configurations that demonstrated the feasibility of achieving the aggressive VAATE goals in propulsion system capabilities at an affordable cost. Through Mr. Lewis' laudable efforts, the Air Force has the necessary jet engine control technologies for the Joint Strike Fighter and F-22 programs, the IHPTET Program is progressing well, and the VAATE program is well established. (Mr. W. Koop, AFRL/PRT, (937) 255-4100)

Mr. Timothy J. Lewis recently received the Meritorious Civilian Service Award

PR PROCESS IMPROVEMENT PATENT PROMISES LOWER COST COMPOSITE MATERIALS: US Patent #6,756,112, titled "Carbon Matrix Composites Fabricated by a Rapid and Low-Cost Process Incorporating In-Situ Polymerization of Wetting Monomers," was issued on 29 June 2004 to Dr. Phillip Wapner[‡] and Dr. Wesley Hoffman of the Propulsion Directorate and Dr. Steven Jones of SMJ Carbon. This patent describes improvements to the In-Situ Densification Process previously described in US Patent #6,706,401. The In-Situ Densification Process is a rapid, low-cost technique for manufacturing thick, high-performance carbon and ceramic composites in the form of uniformly densified, near-net shaped structures. Composite materials manufactured by this process have many structural applications in aerospace and rocket propulsion, such as heat shields, leading edges, and nozzles. Cost is currently the main factor limiting the application of high-performance carbon and ceramic composites, and this process addresses a method to significantly reduce cost. (Dr. W. Hoffman, AFRL/PRSM, (661) 275-5768)

[‡] Dr. Wapner is an on-site contractor in the Propulsion Materials and Applications Branch (AFRL/PRSM).


Drs. Wapner (L), Hoffman (R), and Jones (not pictured) are the co-inventors of a new patent to manufacture high performance, low-cost composite materials