PROPULSION DIRECTORATE

Monthly Accomplishment Report
March 2001

Contents ***Page***

HyTECH FREEJET TESTING SUCCESSFULLY COMPLETED: Freejet testing of the Performance Test Engine (PTE) under the Propulsion Directorate's Hypersonic Technology (HyTech) Program was successfully completed on 15 January 2001. The PTE is a heavyweight, hydrocarbon-fueled scramjet (supersonic combustion ramjet) engine demonstrator being developed by Pratt & Whitney under sponsorship of the Aerospace Propulsion Office (AFRL/PRA). Testing concluded with successful runs at conditions simulating Mach 4.5 flight. Testing at Mach 6.5 was previously completed in December 2000. The HyTech scramjet engine is designed to start producing thrust for a flight test vehicle at Mach 4.5, accelerate, and then cruise at Mach 6.5. Data from this test program, which was performed at GASL in Ronkonkoma, New York, will be used to verify engine performance and operability in the Mach 4.5 to 6.5 flight regime. Although the scramjet engine under development is sized for a tactical missile, the technologies being investigated have widespread applicability to high-speed airbreathing propulsion research. The maturation of high speed airbreathing propulsion technology is a critical step in the development of combined cycle engines that will enable more cost effective, on-demand access to space for future systems. The final test engine is the Ground Demonstration Engine (GDE), which will demonstrate the performance, operation, and structural durability of a flightweight scramjet engine. (R. Norris, AFRL/PRA, (937) 255-2175)

The Performance Test Engine (PTE)

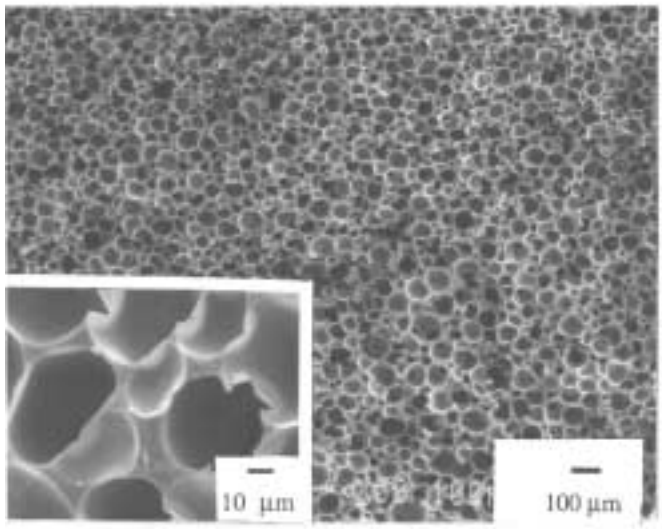
The PTE installed in Leg VI at GASL

IN SITU CARBON-CARBON PROCESS HONORED WITH FLC AWARD: A team of scientists from the Propulsion Directorate's Space and Missile Propulsion Division (AFRL/PRS) has been chosen to receive a 2001 Award for Excellence in Technology Transfer from the Federal Laboratory Consortium (FLC) for Technology Transfer. This team is being honored for work on "In Situ Densification of Carbon-Carbon (C-C) Composites." This new processing technique will produce composite material in 5-25% of the time and at 10-50% the cost of current commercial processes. Furthermore, this process can be used to manufacture parts that are impossible to produce by any other technology. It is projected that use of this process will save the DoD tens of millions of dollars in the procurement of C-C aircraft brakes, rocket nozzles, exit cones, and nose tips. This technology also opens the door for commercial applications that were previously not feasible based on cost. Examples include brake and clutch applications, thermal management, chemical processing, silicon wafer processing, and high temperature furnace elements and components. The team being honored by FLC consists of

Members of the team honored by an FLC Award for Excellence in Technology Transfer

Dr. Wesley Hoffman, Dr. Kevin Chaffee, Phillip Counts, Marietta Fernandez, and Hong Phan from AFRL/PRS; Dr. Steven Jones of SMJ Carbon; and on-site contractors Dr. Phillip Wapner and Thomas Duffey. This team will be honored at the FLC award ceremony to be held on 1 May 2001 in Burlington, Vermont. (W. Hoffman, AFRL/PRSM, (661) 275-5768)

MICROFOAMED MATERIAL SHOWS SIGNIFICANT IMPROVEMENT IN STRENGTH: The Propulsion Directorate, a world leader in POSS (polyhedral oligomeric silsesquioxanes) technology, recently established a three-year DUS&T Program with Wright Materials Research Co (WMR) to combine the significant property enhancements of POSS-polymers with the remarkable strength increases and weight reductions of micro- and nanocellular foams. While most foams demonstrate decreased structural integrity as compared to corresponding non-foamed material, nanocellular foams exhibit mechanical strength increases, and are also optically transparent. WMR was able to foam and perform compression tests on samples provided by AFRL, including a 5 weight % POSS-poly (methyl) methacrylate (PMMA) and a pure PMMA sample. Tests of the two materials showed a greater than 30% increase in compression strength and fracture toughness for the 5 weight % POSS-PMMA as compared to the unmodified PMMA. Furthermore, the POSS-PMMA did not fracture even at up to 70% strain and a stress of greater than 50,000 psi. The modified material is currently being scaled up for a multitude of tests. The current applications foreseen for the material include aerospace uses that require its greater strength and higher temperature operating capability. (S. Phillips, AFRL/PRSM, (661) 275-5416)



A sample of microfoamed material

AIR FORCE INITIATES WORK ON LOW AC LOSS HTS COATED CONDUCTORS: The Propulsion Directorate's Superconductivity Group has initiated work to develop low ac loss high temperature superconducting (HTS) coated conductors. These low ac loss conductors are important to the development of lightweight, compact, high power superconducting generators. This work has been initiated via collaborative efforts with the Superconductivity Group and external partners under two programs: one for the AFOSR International Research Initiative (IRI)

and the other for the Ballistic Missile Defense Organization (BMDO). In the IRI, funding is set aside for collaborative work with Dr. Milan Polak of the Institute of Electrical Engineering Slovak Academy of Sciences and Dr. Archie Campbell of the University of Cambridge. The IRI Team will create and evaluate various resistive barrier structures between superconducting YBCO (yttrium barium copper oxide) filaments in coated tape conductors. The effective barrier resistance as defined in recent technical publications is critical to minimize both coupling and hysteresis ac losses in tape conductors. Measurements of the various barrier resistances will enable correct modeling of the ac loss for several configurations of resistive barriers and YBCO filaments, and allow control of the loss as a function of magnetic field, frequency, and temperature. BMDO has also selected two Small Business Innovation Research (SBIR) initiatives in the new area of low ac loss conductors that will be managed by the Air Force's Superconductivity Group, who advocated their selection. Each will seek effective ways to produce the YBCO coated conductor that will result in lower ac loss. The SBIR Program with Applied Thin Films, Inc is titled "Nano-Dimensional Patterning of YBCO for AC Loss Conductors," and the program with Hy Tech Research, Inc is entitled "Low AC Loss YBCO Coated Conductors." (P. Barnes, AFRL/PRPG, (937) 255-2923)


Dr. Suresh Suri

<u>METHOD FOR PREPARING NOVEL PRECURSOR FOR ENERGETIC COMPOUNDS PATENTED</u>: On 30 January 2001, Dr. Suresh Suri of the Propulsion Directorate's Propellants Branch (AFRL/PRSP) and Dr. Stephen Rodgers, formerly of the Propulsion Directorate, were issued US Patent #6,180,799 for "Sulfalation of Tetraol." The Propellants Branch is tasked with planning, formulating, and directing fundamental research, exploratory, and advanced development of new propellants and propellant technology for application to military space and missile systems. The invention described in this patent provides low cost and efficient methods for preparing chemical compounds that are precursors to a variety of future compounds having energetic properties. This invention offers major improvements in terms of handling, scale-up, and cost over the prior synthetic methodologies used to prepare these compounds. The efficient production of such compounds is key to fulfilling PRSP's mission to develop new propellant technology for the Air Force. (S. Suri, AFRL/PRSP, (661) 275-5952)


Dr. Stephen Rodgers

Want more information?

- The full text of this patent is available at the US Patent & Trademark Office's website by clicking here.

POWELL NAMED PR CGO OF THE QUARTER: 1Lt Orval "Rusty" Powell was named the Propulsion Directorate's Company Grade Officer (CGO) of the Quarter for the 4th quarter of 2000. Lt Powell serves as the International Project Officer for the Advanced Combustor Chamber Concepts (AC3) Program, which is developing cutting edge, cooled composite technologies that have the potential to reduce engine weight by 40%. To complement this US/French cooperative program, he spearheaded a recent Data Exchange Agreement meeting in France on ramjet and scramjet technologies. He was the US delegate responsible for the agenda, and the US delegation consisted of personnel from two Air Force sites, three NASA locations, and five contractor facilities. He also serves as the Government Systems Engineer for the Hypersonic Scramjet Engine Technology (HySET) Program. The HySET Program is focused on developing critical scramjet (supersonic combustion ramjet) engine technologies. The in-house scramjet test facility (Test Cell 22) at Wright-Patterson AFB is currently being upgraded to perform tests in support of the HySET Program. Lt Powell acts as the focal point for enhancements to this key in-house facility, is a vital member of the in-house test/analysis team, and is responsible for the hazardous materials generated by the test facilities in AFRL/PRA. Despite these numerous responsibilities, Lt Powell also takes on a number of additional duties. He was a keyworker for the 2000 Combined Federal Campaign, he actively supports PR's Helping Hands Program to lend aid to underprivileged families, and he mentors high school students through an AIAA Program. Lt Powell is well deserving of this honor. (R. Mercier, AFRL/PRA, (937) 255-5221)


1Lt Orval "Rusty" Powell

PATENT ISSUED FOR NOVEL MICRODEVICES: Researchers in the Propulsion Directorate were recently issued US Patent #6,152,181 titled "Microdevices based on surface tension and wettability that function as sensors, actuators, and other devices." The inventors of this patent are Dr. Phillip Wapner, an on-site contractor at Edwards AFB, and Dr. Wesley Hoffman, a group leader in the Propulsion Materials Applications Branch (AFRL/PRSM). The patent describes microdevices, which operate on principles of surface tension and wettability that are useful as sensors, detectors, actuators, pumps, and other applications. As sensors and detectors, these devices can respond to a variety of stimuli such as pressure, temperature, gravity, acceleration, chemical environment, and magnetic and electric fields. Unlike other microsensors, these devices can be exposed to forces and pressures orders of magnitude greater than their design limit and still return to their original accuracy and precision. By joining these devices together, it is possible, for example, to form complex devices capable of controlling macroscopic flows.

Complex electrical switching operations are also possible using these devices. (W. Hoffman, AFRL/PRSM, (661) 275-5768)

Want more information?

- The full text of this patent is available at the US Patent & Trademark Office's website by clicking here.

Dr. Phillip Wapner

Dr. Wesley Hoffman

Microtube pressure sensor

SMITH NAMED JANUARY EMPLOYEE OF THE MONTH: Ms. Nadine Smith was named the Propulsion Directorate's Employee of the Month for January 2001. For January, the Employee of the Month Award was given in the category of Secretary. Ms. Smith serves as the secretary to the Deputy of the Integration & Operations Division (AFRL/PRO), and she was

instrumental in setting up the new PRO-West Division Office at Edwards AFB. With her supervisor on emergency leave, she single-handedly organized the setup of the new office from furniture to phones to computers. Furthermore, due to the departure of two branch secretaries, she now manages all administrative support for PRO-West. Her responsibilities include all labor hour reporting, travel orders, correspondence, budget tracking, credit card purchases, and much more. In addition to these duties, she also serves as security monitor, safety monitor, vehicle control officer for four Government vehicles, and building custodian for Building 8352 and the Rocket Room. Despite this tremendous workload, the administrative needs of the entire PRO-West organization are being fulfilled. Ms. Smith also enthusiastically takes on additional tasks, such as working on the Combined Federal Campaign and supporting the ceremony naming the Rocket Site as an AIAA Historic Aerospace Site. Ms. Smith is a worthy recipient of this award. (A. Kuphal, AFRL/PRO, (661) 275-5343)

Ms. Nadine Smith