# Synopsis of the SBIR/STTR Session in the Spring 2004 PFC Workshop

A dozen small businesses made presentations at the SBIR/STTR session on May 05, 2004. A portion of these presentations may be found on the PFC web site. The session started with research on CFD/MHD computations and experiments on liquid metals.

Martin Pattison of MetaHeuristics, LLC discussed improvements to his Lattice Boltzmann code including parallelism and the addition of new pre and post-processors. He presented their plans for the Phase-II that included a "Fusion Applications" package. The code uses large eddy simulations for turbulence. It was found that the performance of the application improved linearly with the number of processors.

Neil Morley from UCLA presented for Ramankath Munipalli regarding developments in modeling complex geometries with the HIMAG code of HyperComp, Inc. Solid walls are now included and an anisotropic MHD model was added in conservation form to address DiMES needs. They also included ferromagnetism for commercial client needs.

Robert Stubbers from NPL Associates, Inc. presented recent results from FLIRE regarding helium pumping and scaling. An effective diffusion coefficient was obtained, but was thought to be 2 to 3 orders of magnitude too low. He also presented a wall desorption argument to explain the evolution of helium bubbles in FLIRE.

The session next moved into the subtopic of active cooling technologies. The first speaker of this subtopic, Geoff Campbell of Microvection Inc., showed previous work on microlaminates for scram-jet nozzles with 250 μm size passages. Heat fluxes of 60 to 150 W/cm$^2$ were absorbed with convective heat transfer coefficients near 36,000 W/mK. Copper laminate heatsinks were developed in a phase-I SBIR with DOE and some promising fabrication technology for tungsten microlaminates was investigated.

Pete Dussinger of Advanced Cooling Technologies (ACT) explained the new business relationship with their parent company, Thermacore Inc. He highlighted some truly outstanding firsts in heat transfer and some remarkable high heat flux records for heat pipes and porous media. He discussed porous media applications in EUV lithography sources and klystron accelerator sources; and the development of heat pipes for space applications.

Scott O'Dell of PPI presented a review of recent DOE SBIR projects that exhibited remarkable breadth. Everything from W and Be armor, Li-cooled refractory tubes, nanograined tungsten, nano-porous tungsten for IFE chamber walls, functionally graded material for W to Cu joining, a monolithic W, helium-cooled, porous heat exchanger, and an impressive multitude of W-rod armored mock-ups.

The session then addressed the subtopic of high temperature materials, coatings and joining. Ron Jacobson of Applied Sciences, Inc. (ASI) presented work on VGCF nano-tubes that have nearly twice the thermal conductivity of copper at room temperature. He

discussed the lay-up and manufacture of nano-tube panels and the use of diamond coatings for electrical insulation and corrosion resistance with good thermal conduction. Ron presented some new ideas on the use of VGCF material as a backing for lithium instead of ATJ graphite as proposed in the module-A ALIST concept.

Ramas Raman from Surmet Corp. presented the optical ceramic materials Surmet is currently developing for DoD and others. Of particular interest was the AlON material, a polycrystalline replacement for sapphire in window applications. Surmet, an ISO9001 certified company, has grown considerably in the last few years having acquired a materials group from Raytheon and Advanced Refractory Technologies, Inc. (ART). In addition to ALON, they also produce Al-SiC metal matrix composites, $MgAl_2O_4$ and $Y_2O_3$ powders. Potential pfc opportunities lie in the development of new MHD insulators.

John Moschella from hyTech Research presented their work on corrosion resistant solid Boron cathodes for metal plasma vacuum arcs. The thermal shock resistant Boron cathodes are UHV compatible and operate at 10 $MA/cm^2$ current densities. Such cathodes may find PFC application in the boronization of tokamak first walls.

Stuart Scwhab of Thor Technologies described his company's efforts in the development of $SiC_f/SiC_m$ fiber reinforced panels and co-processing with metal inserts using gyrotron heat sources. He described research for the USMC on ceramic gun barrels and work for EPRI on the repair of thermal barrier coatings. Potential pfc applications that were identified included sol-gel processing of CaO for MHD insulator coatings and the manufacture of SiC blanket ducts with steel shells.

Tim Stewart of Ultramet presented their research on W foams for IFE chamber walls and the development of $SiC_f/SiC_m$ tubes for GenIV applications. The SiC development was identified as useful for current MFE blanket designs. The foam technology developed by Ultramet was perceived to have many applications in blankets as well as high temperature refractory heat exchangers.

Samar Guharay from FM technologies closed the SBIR/STTR session with an interesting presentation on joining of $SiC_f/SiC_m$ composites. They joined 36" long SIC tubes with joint strengths as high as the as-received material. They joined SiC to superalloy, sapphire to stainless steel, and SiC to SiC. The key to joint strength depends on reduced porosity at the joint. Annealing of the joints produced high strengths from 160 to 200 MPa. Joining of SiC ducts in blanket modules as well as the development of ceramic to metal joints is considered a critical technology by the pfc community.

The session concluded with a discussion between members of DOE, the pfc research institutes and the small businesses participants regarding the presentations and the SBIR/STTR solicitation process. The business community recommended that a contact person be listed next to each solicitation subtopic. The contact could then provide clarification of the topic goals and objectives during the proposal writing stage in an effort to improve overall responsiveness to the solicitation.