CATEGORY ARCHIVES: BREAKTHROUGH DISCOVERIES

A Visiting Scientist Program Project ignites a new wave of In-house and University Collaboration

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ARLINGTON – Last year, Dr. Steven Fairchild of AFRL/RXAP spent 4 months embedded at the "Pulsed Power, Beams and Microwave Laboratory," University of New Mexico (UNM), hosted by plasma physicists Professors Edl Schamiloglu and Salvador Portillo. The Lab, with its strong research ties to our own AFRL, was the perfect place for this Visiting Scientist program (VSP) research project, "Novel Micro & Nano-structured Materials for Mitigating Multipactor and Vacuum Breakdown in High Power Microwave (HPM) Devices."

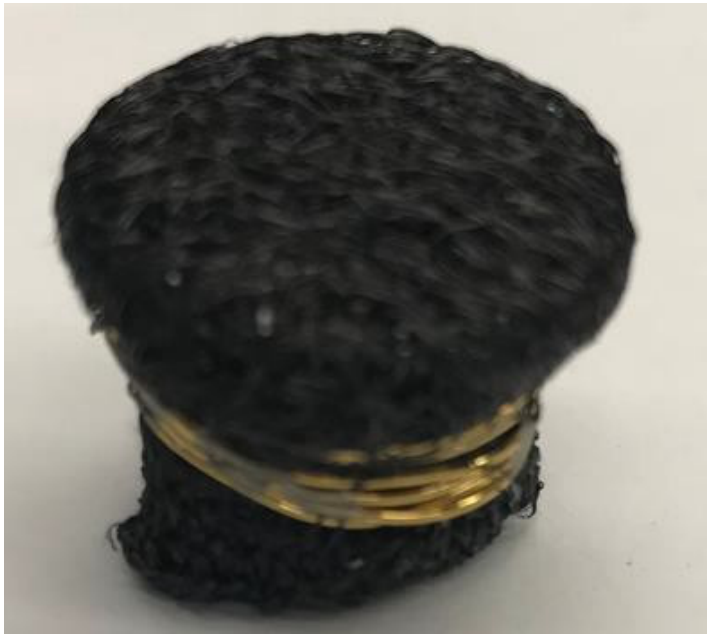
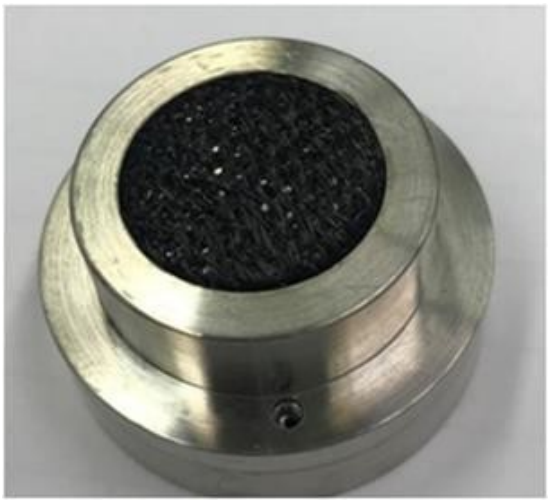
Dr. Fairchild's in-house work has developed novel new carbon nanotube (CNT) bulk fiber cathodes for field emission, field emission for plasma generation, and the plasma for HPM applications.

— Liner Transformer Driver in the Pulsed Power Test Lab at UNM

The VSP allowed access to HPM experts and advanced diagnostic capabilities not available at AFRL/RX. For example, the high voltage, pulsed-power test beds at UNM which simulate actual HPM operational conditions.

The appeal of this project is its broader bonds to others on HPM development

within AFRL. It's a culmination. First, Dr. Fairchild's work on advanced materials for HPM is now part of the core mission requirements at AFRL/RX. Second, materials for high stress in more compact weapon systems are of high interest at AFRL/RW to meet stringent munitions requirements. These field-emission cathodes are meant for compact HPM sources in stand-off, nonkinetic weapons. Next, AFOSR has made considerable investments in the development of advanced materials for improved cathodes and anodes. An EOARD grant on CNTs directly shaped design work at RX leading to this VSP.

- 
- 

Field emission cathode fabricated from CNT fiber using 3D knitting machine at the Functional Fabric Center, Drexel University, mounted into a cathode holder developed for testing at the Pulsed Power Lab at UNM.

Recent other recent grants from AFOSR science portfolios in Plasma and Electro-Energetic Physics and Electromagnetics affected the work directly, as well. One grant with Prof. Matteo Pasquali at Rice University spun-off the company DexMat Inc., which now commercially produces the very CNT fibers now sourced in this VSP through collaboration with the Small Business Innovation Research (SBIR) program.

An AFOSR MURI award, Multipactor and Breakdown Susceptibility and Mitigation in Space-based RF Systems, aligns with HPM work at AFRL/RX, and simultaneously to in-house efforts at AFRL/RD and AFRL/RV.

Since its founding, the UNM Lab's rich history is rooted in AFRL. At present, it is a key participant in the AFOSR Center of Excellence on the "Science of Electronics in Extreme Environments." It is a participant too on a new NRL STTR on high-efficiency HPM sources with links to AFOSR, to which Dr. Fairchild's effort fits. In fact, last year's testing under VSP of the improved CNT-fiber based cathode materials for next-generation HPM weapons systems is expected to continue at UNM in an FY20 VSP, pending resumption of TDY travel.

Next stage testing will determine suitability of the new cathodes for insertion into the HPM source under development in the STTR. The status of where the cathodes stand till testing resumes under the FY20 VSP: These are now prepared as a full fabric surface for compact, large area arrays!

For more information on this VSP project – either its FY19 conclusions or its FY20 pending continuation – please contact stephen.fairchild@us.af.mil; for information on VSP, joanne.maurice@us.af.mil .

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