Atmospheric Plasma Processing of Materials

S&T Campaign: Materials Research
Tier 2: High Strain Rate & Ballistic Materials

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Research Objective

• Utilize novel atmospheric plasma processing methods to enhance performance of ceramic, metallic, polymeric, and composite materials systems.
• Make strides towards understanding the role of atmospheric plasma exposure in altering the near-surface and interfacial chemistry of materials.

Challenges

• Glow-to-arc transitions
• Reproducibility of experimental conditions
• Post-treatment recovery and contamination
• Complex chemical interactions and metastable species

ARL Facilities and Capabilities Available to Support Collaborative Research

• Cylindrical RF Dielectric Barrier Discharge (DBD) system for processing fabrics and polymeric films.
• Roll-to-roll processing capability with fully automated wind/unwind system.
• Microsecond-pulsed DBD planar system for processing ceramics, polymers, and composites.
• Pulsed DBD afterglow system, allowing the treatment of conductive materials.
• Plasma-enhanced chemical vapor deposition (PECVD)
• Optical emission spectroscopy (OES) capabilities
• High-Speed photography for plasma characterization

Complementary Expertise/Facilities/Capabilities Sought in Collaboration

• Power supply design for ultra-fast pulsed (nanosecond) plasma reactors.
• Electrode design for mitigation of microdischarges
• Modeling of atmospheric plasma reactions
• Atmospheric residual gas analysis (aRGA)
• Process/property relationship of PECVD films

Various electrode designs for atmospheric plasma processing including plasma jet (left) and linear DBD (right).

Organic Fiber Composites

Ceramics

Thermoplastics

Patterning