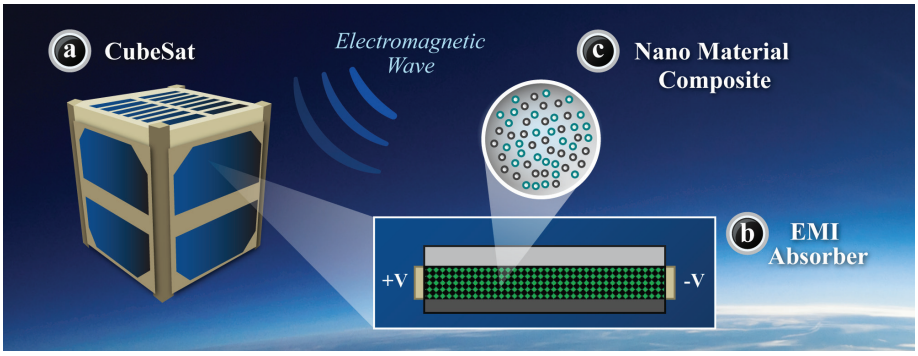
Tunable Electromagnetic Materials for Next-Gen Survivability

Tunable multiferroic and 2D materials for electromagnetic (EM) shielding

We developed tunable multiferroic and 2D materials for electromagnetic shielding. This atomically thin material is engineered for high-performance EM shielding, with minimal weight and thickness, and can be integrated into paints and composites. The material is compliant with high altitudes, new builds, and retrofits.

DoD threats addressed in this IRAD include High-Altitude Electromagnetic Pulse (HEMP), a nuclear detonation at high-altitude that can generate an intense electromagnetic pulse capable of disabling electronics, communications, and critical infrastructure over large regions, and Directed Energy Weapons (DEWs), microwave and radio-frequency weapons designed to disrupt or destroy electronic systems.



Procedure

- **Threat identification and Requirements Definition:** Confirmed HEMP and directed energy threats in collaboration with AFRL, NRO, ODNI, and NASIC
  - Defined survivability, tunability, and integration goals for novel shielding materials
- **Material Design and Synthesis:** Engineered tunable multiferroic and 2D materials for EM interactions
  - Focused on frequency agility, low weight, and composite compatibility
- **Form Factor Integration:** Incorporated materials into paints and structural composites
- **Testing and Validation:** Lab and range testing under EM stress conditions where we evaluated shielding effectiveness, durability, and tunability
- **Transition & Collaboration:** Partnered with AFRL and other DoD stakeholders to provide future materials integration into defense platforms and infrastructure

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Key Features

- Tunable multiferroic materials
- 2D material integration
- Multifunctional form factors
- High-altitude electromagnetic pulse HEMP-focused design
- Nonprofit innovation model
- AFRL collaboration

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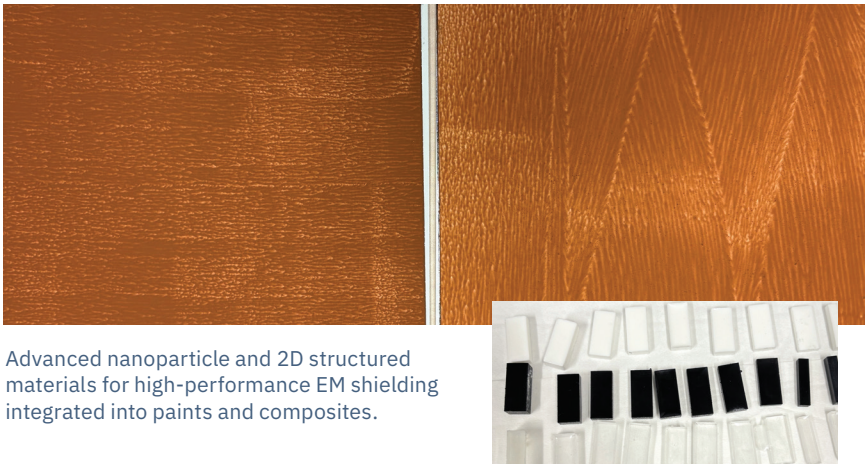
Observations

This IRAD specifically targets protection against the E1 component (fast, high amplitude pulse) that threatens sensitive electronics, and E3 component (slow pulse) that affects power grids. Our materials provide adaptive, frequency-tunable shielding to counter evolving DEW capabilities. It also addresses Electronic Warfare (EW) and Signal Intelligence (SIGINT) threats that exploit EM emissions for tracking or disruption, enhancing survivability and resilience of platforms and infrastructure in the face of asymmetric, non-kinetic threats.



Advanced nanoparticle and 2D structured materials for high-performance EM shielding integrated into paints and composites.

Next Steps

Next, we will set up the full materials synthesis laboratory where we can support the large scale 2D materials manufacturing equipment. Once the synthesis laboratory is ready, we can refine the recipes for our multiferroic and tunable stacked structures.

After the 2D material equipment is in place, we will scale up production and work toward a commercialization pathway for sustained transition of the material to DoD platforms.

Small-scale capability prior to materials synthesis laboratory installation

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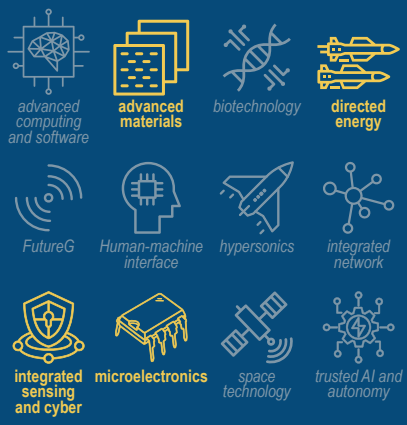
Critical Tech Areas



DoD Priorities

1. Southwest Border Activities
2. Combating Transnational Criminal Organizations in the Western Hemisphere
3. Audit
4. Nuclear Modernization (including NC3)
5. Collaborative Combat Aircraft (CCAs)
6. Virginia-class Submarines
7. Executable Surface Ships
8. Homeland Missile Defense
9. One-Way Attack/Autonomous Systems
10. Counter-small UAS Initiatives
11. Priority Critical Cybersecurity
12. Munitions
13. Core Readiness, including full DRT funding
14. Munitions and Energetics Organic Industrial Bases
15. Executable INDOPACOM MILCON
16. Combatant Command support agency funding for INDOPACOM, NORTHCOM, SPACECOM, STRATCOM, CYBERCOM, and TRANSCOM
17. Medical Private-Sector Care