



DRAGONSCALE™

Advanced Passive Thermal Runaway Mitigation for Military Lithium-Ion Battery Systems

Lightweight • >1000°C Thermal Stability • Smoke-Only Suppression • Passive / Non-Invasive • Maintains MIL-PRF-32565 Performance

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Pickett Applied Technologies Laboratories, LLC
Service-Disabled Veteran-Owned Small Business (SDVOSB)

Executive Summary

DragonScale™ is a lightweight, insertable protein-graphene nanomaterial liner designed to suppress thermal runaway propagation in lithium-ion batteries to smoke-only levels. Developed by a U.S. Navy CIWS veteran, it offers a practical, passive solution that maintains full compliance with MIL-PRF-32565 Type 2 requirements while significantly improving safety in contested and civilian environments.

The Problem: Thermal Runaway in Military 6T Batteries

The U.S. military faces a persistent and costly challenge with MIL-PRF-32565 Type 2 Li-ion 6T batteries. Thermal runaway events — triggered by mechanical puncture, electrical overcharge, or external thermal exposure up to $150^{\circ}\text{C} \pm 10^{\circ}\text{C}$ — compromise operational reliability in contested environments and result in over \$75 million in annual costs from premature battery replacements, vehicle downtime, and secondary repairs.

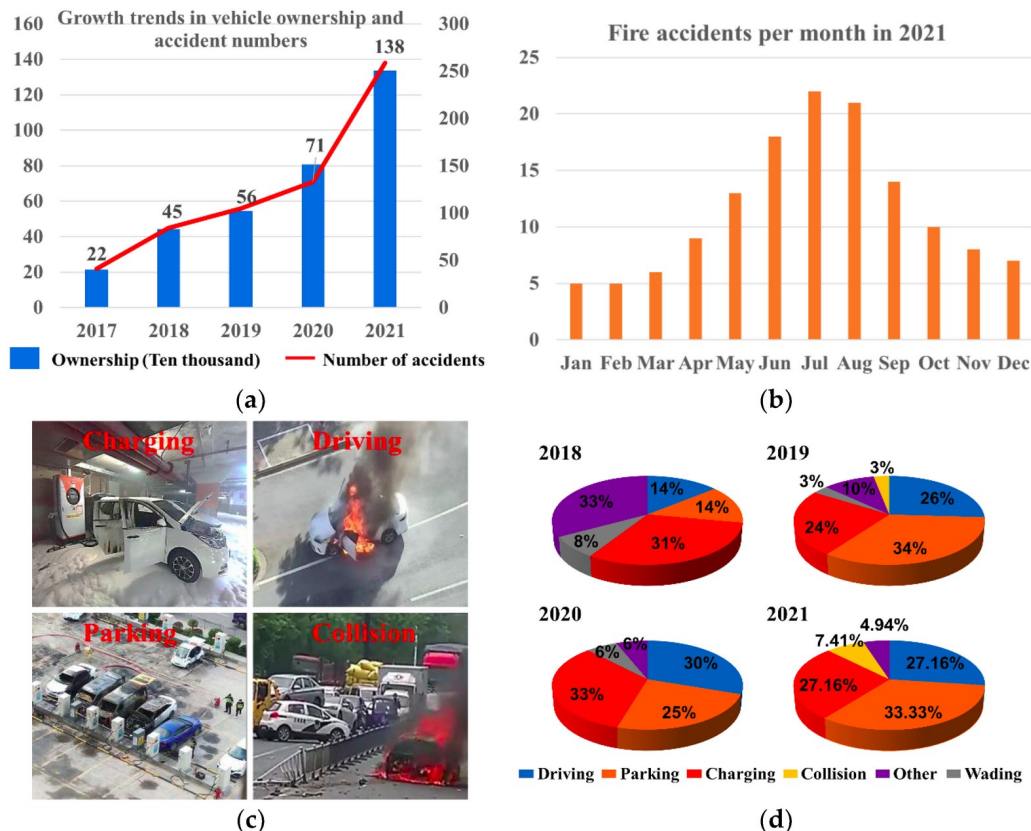


Figure 1: Investigation of EV fire accidents: (a) the number of EVs and fire accidents, with incomplete statistics; (b) the number of fire accidents per month in 2021; (c) fire accident photos; (d) the vehicle status at the time of the fire accident.

Source: Lai, X., et al. (2022). A Review of Lithium-Ion Battery Failure Hazards. Batteries, 8(11), 248.

his challenge extends well beyond military applications. In the civilian sector, lithium-ion battery fires in e-bikes, e-scooters, and other personal mobility devices have become a growing public safety concern. Fire departments in major cities have reported sharp increases in incidents; New York City alone recorded 268 lithium-ion battery fires in 2023 and 279 in 2024, with e-mobility devices as a leading contributor. Similar trends have been documented in London, where the Fire Brigade attended a record 206 e-bike and e-scooter fires in 2025. Nationwide data from UL Solutions indicates more than 3,000 fires involving lithium-ion battery-powered consumer devices since 2022. Many of these incidents involve aftermarket or modified battery packs and have been widely documented in news coverage and public safety reports.

Current solutions have significant limitations. Phase Change Materials (PCMs), while used for heat absorption, can ignite or contribute to fire spread when directly exposed to flame or extreme abuse. Active venting systems add complexity, power draw, and potential points of failure. There is a clear need for a passive, lightweight, high-temperature solution that does not alter cell chemistry or internal battery structure — one that can address both military requirements and the growing demands of commercial electric mobility and energy storage markets.

The Opportunity

DragonScale directly addresses Topic A254-P050 by improving abuse tolerance in individual MIL-PRF-32565 Type 2 Li-ion 6T batteries. This is essential for vehicle safety and reliability in Multi-Domain Operations (MDO), particularly for platforms such as Stryker and JLTV operating in silent-watch and Battle Override modes.

Operational Benefits in Contested Environments

Battle Override Mode — In this critical operating state, safety limiters are deliberately bypassed to prioritize mobility during combat. DragonScale™ extends the operational window by suppressing propagation without immediate fire, even when batteries are pushed beyond standard thermal and electrical envelopes during high-draw maneuvers or prolonged silent-watch.

Silent Watch Reliability — Engine-off missions rely on battery power for sensors and communications. DragonScale™ targets smoke-only outcomes under abuse, eliminating visible or IR-detectable fire signatures and preserving stealth in contested environments.

Maintained Performance — The insertable design maintains compliance with MIL-PRF-32565 Type 2 requirements (minimum 55 Ah capacity, ≥ 200 Wh/kg energy density, $\geq 1,000$ cycle life) while delivering enhanced abuse tolerance.

The Solution: DragonScale™

DragonScale is a lightweight, insertable protein-graphene nanomaterial liner that absorbs heat to suppress thermal runaway propagation to smoke-only levels (targeting Hazard Severity Level 4 per SAE J2464) without altering cell chemistry or internal structure.

Key Performance Characteristics

- Survives extreme temperatures: Pre-submission testing to 1200°C demonstrated maintained structural integrity and effective heat management.
- Lightweight: Density of 1.2427 g/cm³ adds approximately 2.75 kg (<12% of typical 6T battery mass) over ~2,210 cm³ volume.
- Passive & non-invasive: No active components, no power draw, and installs without modifying the existing battery case or cell chemistry.
- Superior to PCMs: Combines heat absorption with structural integrity; does not ignite or spread flame under extreme abuse.
- Maintains performance: Designed to preserve ≥200 Wh/kg energy density and ≥1,000 cycle life per MIL-PRF-32565 Type 2.

Why DragonScale Outperforms Alternatives

Unlike phase change materials that can ignite or contribute to fire spread when exposed to extreme conditions, DragonScale combines heat absorption with structural integrity. Pre-submission 1200°C flash temperature testing confirmed superior resistance to ignition and flame propagation while adding minimal weight compared to many PCM composites.

Initial Proof-of-Concept Thermal Stability Testing

A 7 mm thick DragonScale sample was subjected to approximately 2200°F (1204°C) at the focal point of a 10-inch Fresnel lens for 10 seconds. A thermocouple placed directly in the focal zone confirmed the temperature. The sample exhibited only a small wisp of smoke and minor surface browning, while maintaining structural integrity with no flame propagation or catastrophic failure. This early result supports the material's potential for extreme-temperature applications. Further controlled testing (including side-by-side abuse testing per SAE J2464) is planned.

Technical Approach

DragonScale leverages bio-derived protein matrices for thermal binding and graphene's low thermal conductivity (~0.02 W/m·K) for efficient heat dissipation. The approach is grounded in established nanomaterial principles for passive mitigation without cell modification.

A focused 6-month Phase I plan integrates material synthesis, thermal modeling (Python/NumPy-SciPy validated against COMSOL), and targeted abuse testing (SAE J2464 nail penetration, overcharge, external short circuit) subcontracted to an accredited independent lab. Success criteria include suppression of thermal runaway to smoke-only response (HSL ≤ 4) while maintaining full MIL-PRF-32565 Type 2 performance minima.

Dual-Use Commercial Potential

The same core technology has strong applicability in the commercial electric vehicle and energy storage markets. The global EV battery thermal management and safety systems market is projected to grow significantly through 2030, driven by increasing EV adoption and tightening safety regulations. DragonScale's dual-use design positions it for licensing, partnerships, or direct integration with EV manufacturers seeking improved abuse tolerance without compromising energy density or adding significant weight.

About Pickett Applied Technologies Laboratories

Pickett Applied Technologies Laboratories, LLC (PAT Labs) is a Service-Disabled Veteran-Owned Small Business (SDVOSB) founded in March 2025 by Robert Pickett, a U.S. Navy veteran and former CIWS (Phalanx) Fire Control Technician (NEC-1127). The company is ISO 9001:2015 and ISO 27001:2022 certified, with CAGE 11BD8 and UEI WQKVG2H5LTM5.

In just 15 months, PAT Labs has achieved a granted USPTO patent (CricoPort emergency airway device), multiple qualified DoD white papers under major BAAs, and an active Navy SBIR submission — all while the founder maintained a full-time W-2 position. This demonstrates unusual speed of execution and technical credibility in the defense innovation space.

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CAGE: 11BD8 | SDVOSB | ISO 9001:2015 + ISO 27001:2022

Founder retains 51%+ ownership and full operational control as SDVOSB — protecting independence and eligibility for government contracts.