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Department of War (DoW) Perspective

Brief for Alignment on Artificial Intelligence for Materials to Secure U.S. Leadership



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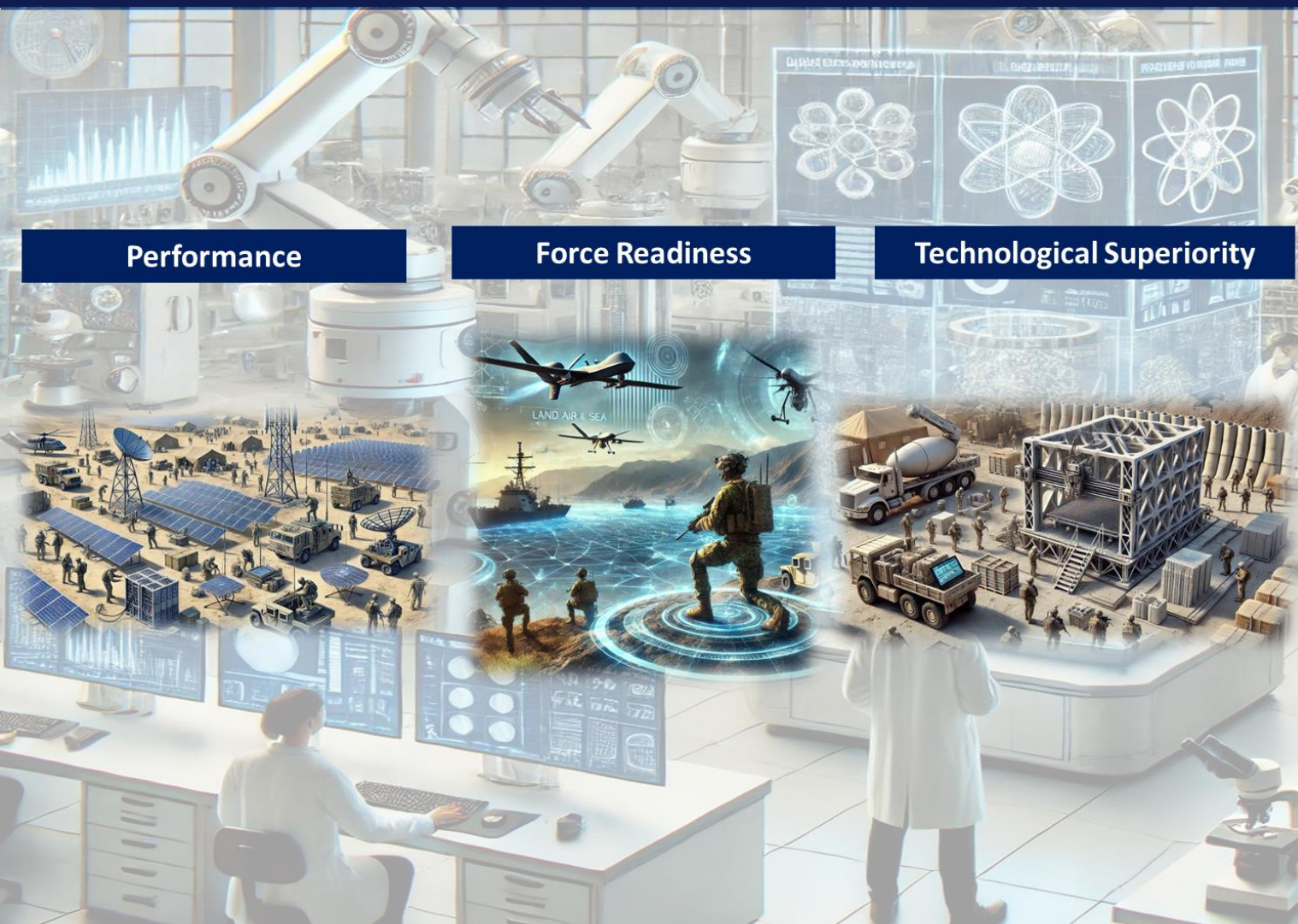
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DoW Advanced Materials



Winning the **Great Power Competition** hinges on **Transformational Warfighter Technologies** that require access to ***Advanced Materials***

Strategic Importance of Advanced Materials

Global Competitiveness

United States is currently outpaced in materials and production



Technology	Tech monopoly risk	Top 5 countries				
Advanced composite materials	9/10 4.1					
		45.4%	11.7%	6.2%	4.1%	4.0%
Advanced protection	8/10 3.4					
		43.5%	12.9%	4.8%	4.1%	2.9%
Coatings	10/10 11.6					
		62.5%	5.4%	5.3%	3.0%	2.8%
High specification machining processes	9/10 3.4					
		42.8%	12.6%	10.6%	3.5%	3.0%
Nanoscale materials and manufacturing	10/10 11.2					
		60.6%	5.4%	5.2%	4.0%	3.6%
Novel metamaterials	9/10 4.0					
		51.7%	12.8%	4.2%	3.4%	2.7%
Smart materials	9/10 6.0					
		45.1%	7.7%	5.2%	5.2%	3.3%
Advanced explosives and energetic materials	6/10 2.9					
		53.0%	18.1%	4.4%	3.6%	3.2%
Advanced magnets and superconductors	5/10 2.2					
		33.3%	15.0%	7.4%	6.8%	5.2%
Continuous-flow chemical synthesis	5/10 2.3					
		29.1%	12.8%	5.2%	4.6%	4.1%
Critical minerals extraction and processing	7/10 3.9					
		42.0%	10.7%	5.1%	2.6%	2.3%
Wide and ultrawide bandgap semiconductors	6/10 2.4					
		42.6%	17.6%	6.1%	4.9%	4.1%
Additive manufacturing	6/10 1.4					
		24.6%	18.0%	5.9%	5.0%	4.5%

ASPI's two-decade critical technology tracker: the rewards of long-term research investment, ASPI, Canberra, 2024

Operational Value

Materials are core to every Warfighter product

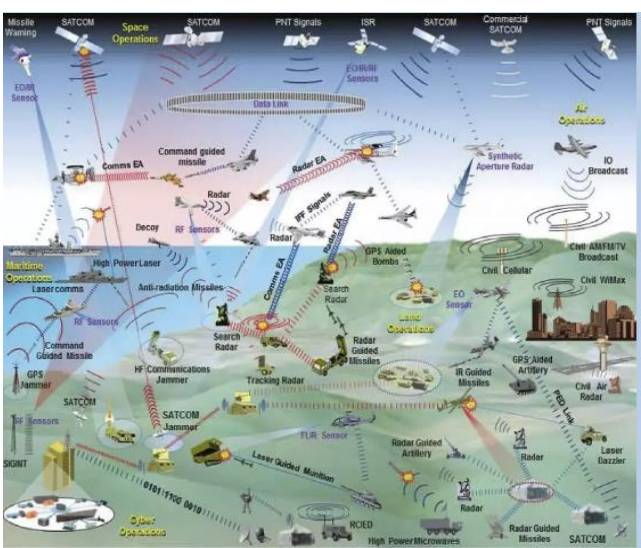


Image from JADC2

Transformational Capabilities

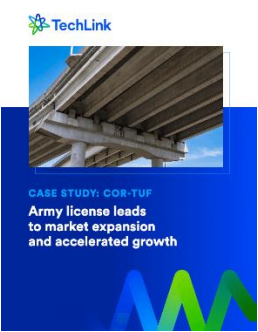


New Materials

Economic Value

Supply chain diversification increases economic output and jobs

- Increasing demands in aerospace, communications, and semiconductors will yield robust growth in 2D, electronic, and 3D printing materials
- DoW materials patents account for 14% of license agreements with industry



Techlink: National Economic Impacts of DOD Technology License Agreements with U.S. Industry, 2000-2021

Strategic competitions are lost without materials → Cannot wait 10+ yrs for new solutions!



DoW AI and AIM Strategies

To deliver material solutions faster, need convergence of AI/AE/AM to accelerate R&D and expedite transitions to industry and Warfighter technologies

EO 14179 and DoW Response

EO 14179 “Removing Barriers to American Leadership in Artificial Intelligence” (JAN 2025) → Develop an AI action plan to “solidify our position as the global leader in AI...”

<https://www.govinfo.gov/content/pkg/DCPD-202500170/pdf/DCPD-202500170.pdf>

“Artificial Intelligence Strategy for the Department of War” (JAN 2026) directs the DoW to “accelerate America's Military AI Dominance by becoming an ‘AI-first’ warfighting force” and:

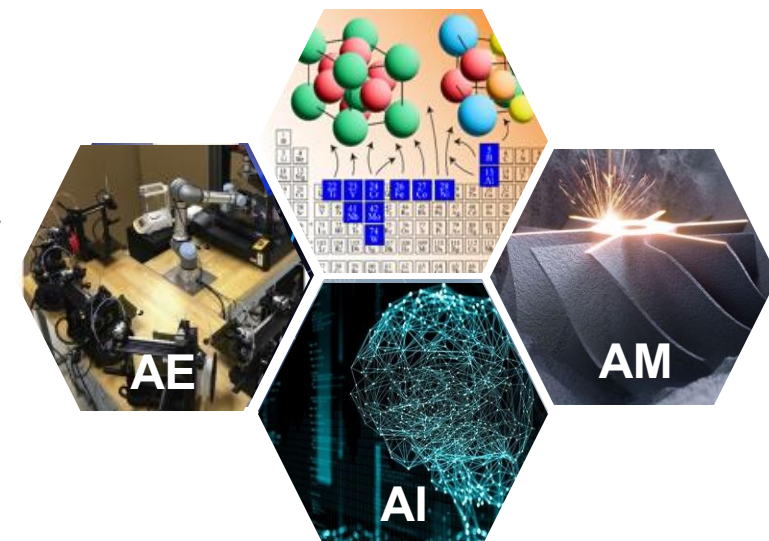
- **Unleash DoW-wide experimentation with leading AI models**
- Identify and eliminate bureaucratic barriers to AI integration
- Focus investment to leverage core asymmetric advantages (e.g., AI computing, model innovation, operational data)
- Execute seven "Pace-Setting Projects" to:
 - Demonstrate the accelerated pace of execution, focus, and ethos to stay ahead
 - **Rapidly build out and adopt foundational AI enablers (e.g., data, models, policies, infrastructure, and talent)**

<https://media.defense.gov/2026/Jan/12/2003855671/-1/-1/0/ARTIFICIAL-INTELLIGENCE-STRATEGY-FOR-THE-DEPARTMENT-OF-WAR.PDF>

OUSW(R&E) AMO AI/AE/AM campaign: *Deliver DoW-wide strategy to implement AI/AE/AM for materials discovery → characterization → manufacturing at scale → qualification/certification and amplify R&D*

- AI and ML tools across entire materials design cycle
- AE to accelerate optimization of Structure – Process – Performance – Manufacturability
- AM for scale and producibility
- Digital framework development to support AI/AE/AM

Goal: Reduce development cycle by >100X



EO = Executive Order

ML = Machine Learning

R&D = Research and development

AI = Artificial intelligence

AE = Autonomous experimentation

AM = Advanced manufacturing

Need dramatic shift in materials R&D to maintain technological advantage and global competitiveness



DoW Obstacles and Industry Opportunities for AIM

DoW AIM Obstacles

- **Insufficient Funding:** Considerable investments are still required to unlock next generation AI-integrated laboratories
 - Hardware (for synthesis, processing, characterization, testing)
 - Software (support for AI-driven workflows, active learning, materials as a design parameter)
 - Data management (via federated/democratized architectures and FAIR “Findability, Accessibility, Interoperability, Reuse” principles)
- **Outdated Process Paradigms:** Need more digitization (e.g., digital engineering, digital twins, digital manufacturing)
- **Decentralization:** Need more centralized authority; data silos and interoperability issues hinder cross-collaboration
- **Inadequate Ecosystem:** Lack of infrastructure, including facilities, to implement AIM capabilities that enable scale-up, qualification and certification, and recycling of materials
- **Undertrained Workforce:** Personnel are not prepared to adopt AI, autonomy, robotics into materials R&D workflows
- **Limited (or Nascent) Dual-Use Efforts:** Building robust and sustainable AIM practices for the DoW and its industrial base requires strategic public-private partnerships

Industry AIM Opportunities

- **Data Interoperability**
 - Engage on open standards definition and interchange formats → Consider models like the Khronos Group
- **Qualification and Certification**
 - Establish testing and evaluation approaches that accelerate the transition of materials from discovery to application
- **Infrastructure and Ecosystem**
 - Participate in public-private partnerships to help inform federal investments and understand demand signals
 - DoW Manufacturing Innovation Institutes and other Research Centers
 - Nat'l Science Foundation Industry-University Coop. Research Centers
 - Department of Energy (DOE) Supercomputing and other Centers
 - Monitor Other Transaction Authorities (OTAs) and join their consortia to identify upcoming opportunities and collaborate
 - *DoW OTAs:* Cornerstone, Strategic and Spectrum Missions Advanced Resilient Trusted Systems (S2MARTS), etc.
 - *DoW Consortia:* Defense Industrial Base Consortium (DIBC), National Security Technology Accelerator (NSTXL), etc.

Government, Industry, & Academia must align investments to deliver near-term needs *while* building enduring AIM capabilities

DoW Challenges and Investment Priorities

Sustainable Munitions

Accelerate and expand domestic manufacturing capacity for munitions and open the pipeline for novel materials qualification in new systems



The DoW Munitions Acceleration Council identified 14 critical weapons.

<https://breakingdefense.com/2026/04/pentagons-munitions-acceleration-council-identifies-14-criticalweapons-for-2027/>



Solid rocket motors (SRMs) are critical limiters. The DoW is investing in its industrial base via the Defense Production Act to expand SRM production.

<https://spacenews.com/pentagon-awards-new-contracts-to-boost-solid-rocket-motor-output/>



The Department of Air Force is investing to establish defense “manufacturing as a service” through Endless Forge.

<https://sam.gov/opp/0b0e993395c2486d80014e99b7b5070b/view>

Advanced Composites and Structures

Establish advanced manufacturing methodologies to secure production and accelerate materials R&D for next-generation composite and structural materials



National Institute for Aviation Research (NIAR) maintains the Composite Materials Handbook, providing standards for composites testing and development.

<https://www.cmh17.org/>



Institute for Advanced Composites Manufacturing Innovation (IACMI) organizes public-private engagement for composites maturation, driven by DoW and DOE stakeholders.

<https://www.iacmi.org/>



National Aeronautics and Space Administration Hi-Rate Composite Aircraft Manufacturing (HiCAM) investments aim to increase production of aerospace composites.

<https://www.nasa.gov/directorates/armd/aavp/hicam/about-hicam/>



DoW Challenges and Investment Priorities

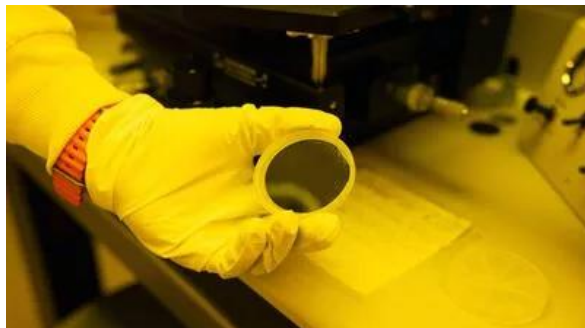
Semiconductors: Beyond Gallium Nitride

Mature domestic wide bandgap and ultra-wide bandgap (UWBG) materials to deliver significant performance improvements for power electronics and similar devices



Defense Advanced Research Projects Agency portfolio focuses on material production of UWBGs through the Microsystems Technology Office.

<https://www.darpa.mil/research/programs/uwbgs-band-gap>



Army Research Laboratory investing \$14M into academia to accelerate R&D into UWBG devices.

<https://www.asminternational.org/texas-tech-to-earn-14m-for-advanced-semiconductor-power-devices-program/>

Resilient Quantum Materials

Drive leap-ahead capabilities for quantum devices via new domestic materials, especially in critically limited supply chains

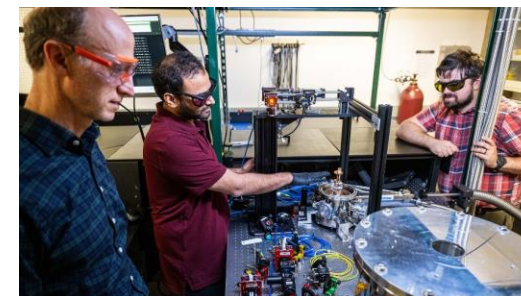
Quantum and Battlefield Information Dominance (Q-BID) identified as an OUSW(R&E) Critical Technology Area.

<https://www.cto.mil/cta/>



DOE Genesis Mission targets domestic capability for quantum materials synthesis and production.

<https://www.energy.gov/science/articles/us-department-energy-advances-domestic-capabilities-producing-quantum-materials>



Air Force Office of Scientific Research invests \$1.5M in basic research to accelerate materials development for quantum technologies.

<https://now.uiowa.edu/news/2026/01/ui-wins-award-to-accelerate-materials-science-research>