Next-Gen Alumina Ceramic AM: Where Sustainability & Efficiency Are Won (or Lost)

Mansura Islam
Eaton Corporation
May 5, 2026

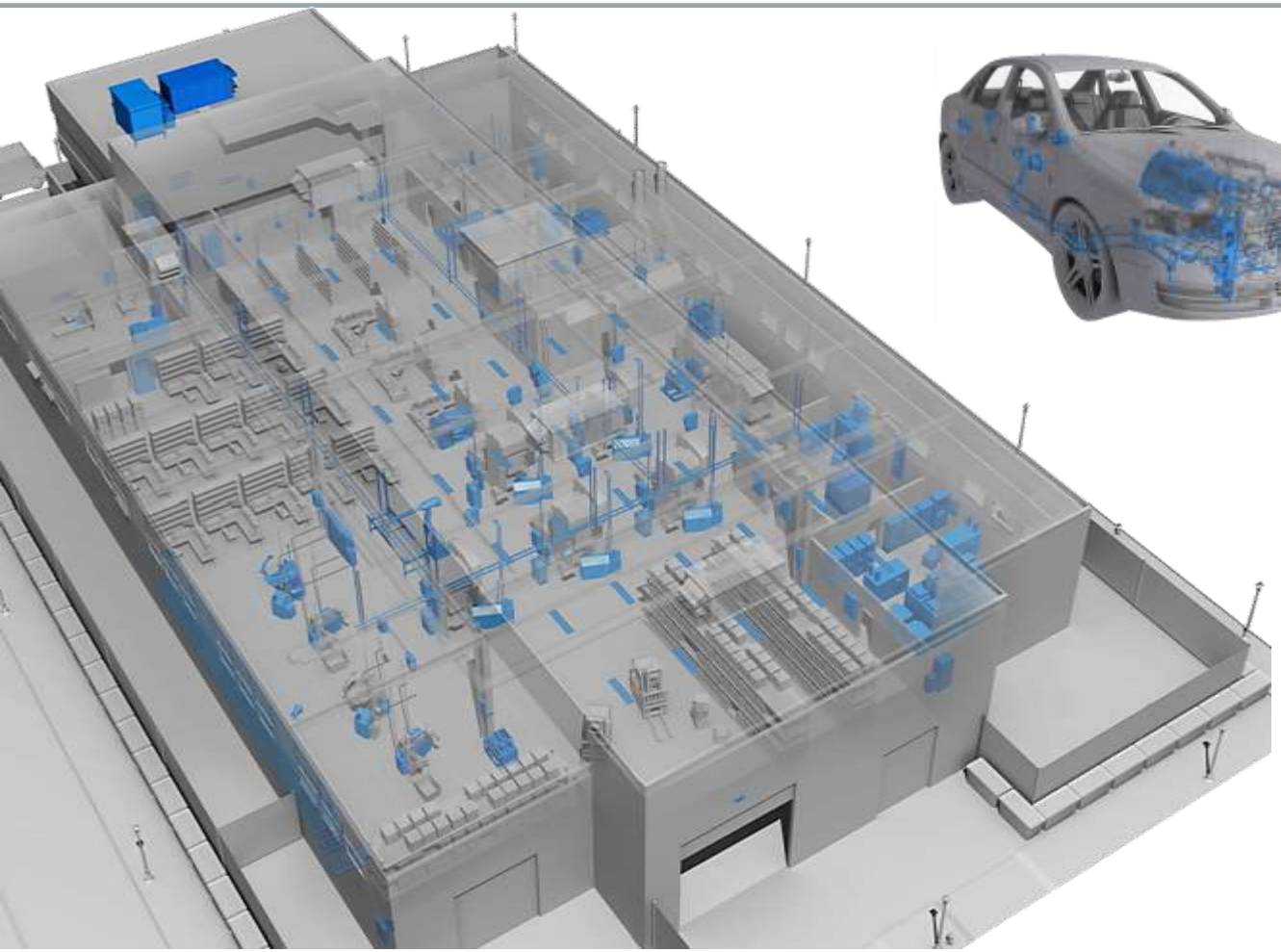
Ceramics Expo 2026
Cleveland, OH



Powering Business Worldwide

© 2026 Eaton. All rights reserved
©.

Eaton products are everywhere









Eaton's Vision: To improve the **quality of life and the environment** through the use of power management technologies and services

EATON
Powering Business Worldwide

© 2026 Eaton. All rights reserved.

Why Alumina AM for High-Performance Power Applications

Flexural Strength
Validated modulus & fracture toughness

Hardness & Density
Ensure mechanical durability

Thermal Conductivity
Enable efficient heat dissipation

- **Power-dense designs, without thermal or electrical compromise**
  Alumina AM combines high dielectric strength with heat dissipation, enabling compact, high-voltage Eaton power systems that run cooler and more reliably.
- **Design freedom where conventional ceramics hit a wall**
  Additive manufacturing allows complex, integrated insulation and thermal features that support Eaton's next-gen power electronics, switchgear, and EV infrastructure architectures.
- **Integration that reduces parts, interfaces, and risk**
  Alumina AM enables monolithic and multi-functional ceramic components, reducing assembly steps, interfaces, and variability in high-performance power systems.

Powering Business Worldwide

© 2026 Eaton. All rights reserved.

Ceramic AM Workflow and the Hotspots

The printer is only one step—the "real factory" is cleaning, drying, and the furnace where yield and quality are determined.



Ceramic resin



SLA printing



Washing and cleaning



Airdrying



De-binding and sintering



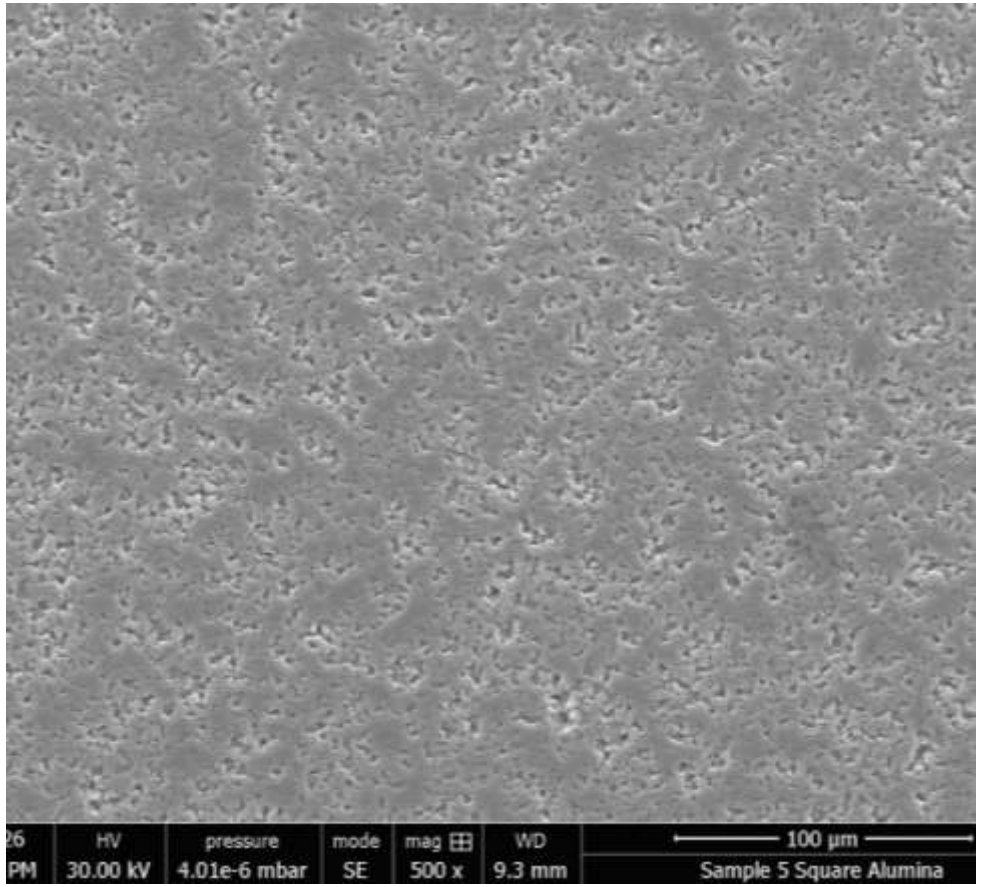
Finished parts

- ***Hotspot 1***: Cleaning residue and handling damage during washing lead to yield loss and scrap risk.
- ***Hotspot 2*****:** Dryness control drives defects during debind and sinter phases, with incomplete drying causing outcome drift.
- ***Hotspot 3***: Sintering limits on thickness create cycle time and quality barriers for scaling to complex geometries.

Powering Business Worldwide

© 2026 Eaton. All rights reserved.

What We're Achieving: Property Snapshot



3D printed Alumina
(97.5% Dense)

1836 HV

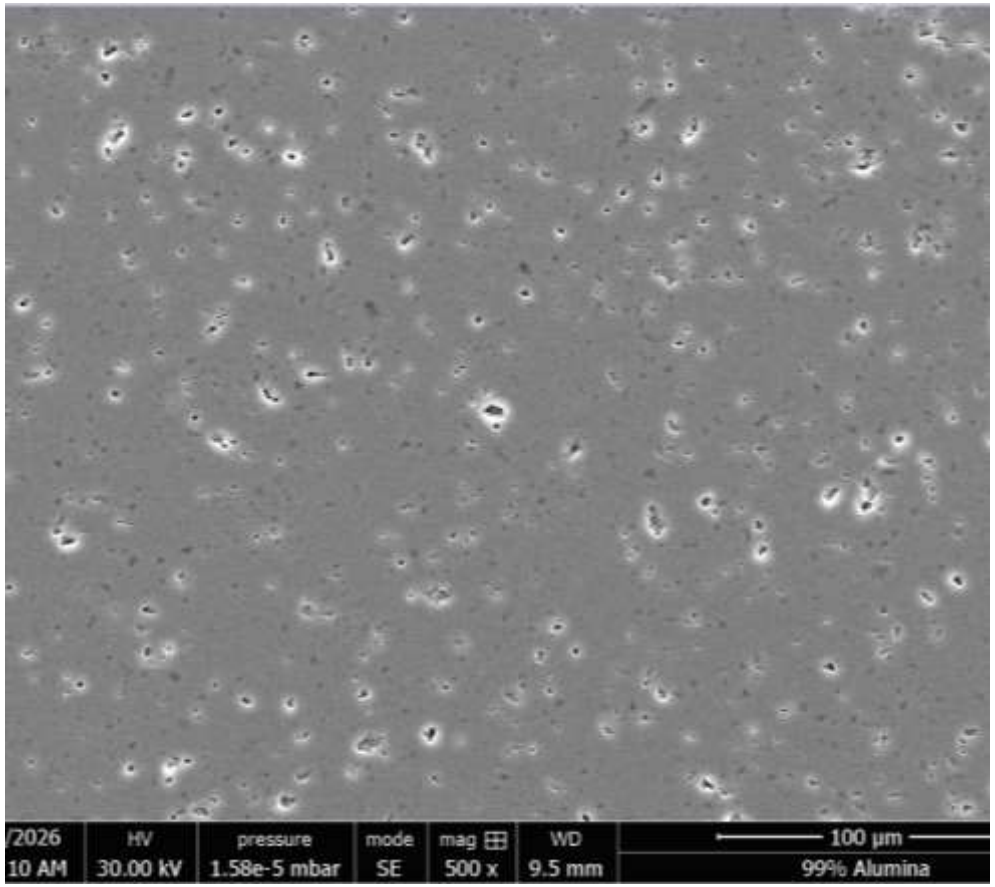
Microhardness
(Vickers)

32.63

Thermal Conductivity
(W/m·K)

97.5 %

Relative Density



Conventional Alumina
(99% Dense)

Powering Business Worldwide

© 2026 Eaton. All rights reserved.

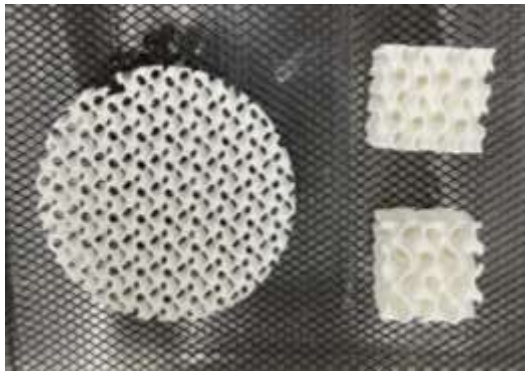
What Still Blocks Scale and What Works Today

Top Barriers to Scale

~2 min individual part cleaning guideline

~45°C extended controlled drying protocol

Thickness limits remains **key scaling barrier**







Practical Playbook for Today

- Clean parts individually using ~2-minute guideline per part to improve consistency
- Use gentle airflow with controlled drying at ~45°C to avoid cracking or warping
- Optimize geometry with lattices and thin-wall designs to reduce sintering risk

Outlook and Next Focus

- Sintering cycle optimization through systematic experimentation with debind profiles and heating rates.
- Enabling thicker geometries through advanced sintering and improved formulations.

Powering Business Worldwide

© 2026 Eaton. All rights reserved.



Questions?

Powering Business Worldwide

© 2026 Eaton. All rights reserved.



© 2026 Eaton. All rights reserved.