FORGE NANO

Global HQ:
12300 Grant St #110, Thornton, Colorado 80241
Phone: +1. 720.259.8579

Environmental Protection

Electronic components in high reliability systems must endure harsh conditions. At the same time,the IC industry evolved to thinner and lighter packaging that increases IC sensitivity to the environment and accelerates degradation.

ALD-Cap® is a flexible ceramic coating that was developed by Sundew to provide hermetic environmental protection without the need for specialty hermetic packaging used in MIL-STD ICs. ALD-Cap® passes various endurance testing and has been successfully used by the US Navy to provide low-cost replacement to hermetically packaged on-ship radar components. Sundew was honored to be recognized in 2008 by the US Navy as a “Navy Small Business Success Story” for this achievement.

ALD-Cap® coatings provide barrier performance that surpasses high-quality alternative conformal coatings such as Parylene or CVD at reduced cost. Hermetic MIL-Standard durability is achieved witha coating thickness as low as 200 nm, and process-temperatures as low as 125° C.

Customer Testimony:

Raytheon utilized an ALD tool that was manufactured by Forge Nano …

“The ALD FETs had a much lower failure rate than the original SiN FETs. Failure rates this low in a HAST test extrapolate to 100s of years of operation under worst-case natural conditions for ALD MMICs”

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Advantages and Benefits:

- 100% conformal
- Ceramic films
- Extremely low-permeability barrier to gases, moisture, and more
- Flexible
- Thin coating (200-500 nm)
- Straightforward masking of contacts and test-points
- Low temperature deposition (down to 70° C)
- Atomic level control of film properties
- Truly hermetic – first thin film encapsulation to pass MIL-STD 883E testing
- Passes MIL-STD 883E, JEDEC-A102 test, > 1000 hours HAST
- Deployed on Navy fleet
- Tested to protect RF MMICs to 100s of years of MTTF
- Improves RF performance of MMICs

Capabilities:

- Encapsulation at the wafer-level, die-level or PCB-level
- Easily re-workable
- Incorporates nanolaminated film-stacks to enhance adhesion and flexibility
- Replaces SiN-Cap at the wafer-level
- Dual-use as tin-whiskers protection coating

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About Forge Nano

Forge Nano is a leading materials science company harnessing the power of Atomic Armor, the company's proprietary ALD nanocoating technology, to accelerate manufacturing innovation, transform product performance and achieve a more sustainable future for a range of industries around the world. Atomic Armor produces superior coatings that can unlock a material's performance at the atomic level and deliver custom solutions from small-scale R&D and laboratory work to large-scale, high-volume production lines. A range of materials can be enhanced through Atomic Armor, including batteries, medical devices, catalysts, propellants and 3D additives. Forge Nano has received major support and signed meaningful partnerships with Volkswagen, LG Technology Ventures, Mitsui Kinzoku, Air Liquide and Sumitomo Corporation of Americas, largely as a result of the company's innovation in the Lithium-ion battery industry and successful track record of improving product performance and safety while reducing cost.

Forge Nano's Capabilities

- **>20 in-house ALD systems for coating of wafers, powders and objects**
  - Including research, pilot and commercial scale systems capable of processing anywhere from 1.0 g to 30,000 kg powder or extrudates per day
  - Fast deposition times up to 30nm per minute for rapid Al_2O_3 ALD coating solutions
- **The world's most knowledgeable and experienced team for ALD onto a range of materials**
  - PhD scientists, certified Professional Engineers, career scientists
  - 20+ years' experience designing and building powder ALD systems

Working with Forge Nano

Forge Nano assists customers daily with both R&D and commercialization of ALD-enabled materials. For R&D, we offer research services for proofs of concept and also sell our R&D equipment globally. For commercialization, we offer joint development of products, production equipment and IP licensing.