

SURFACE ENGINEERING OF FUEL CELL COMPONENTS USING LARGE AREA FILTERED ARC TECHNOLOGY

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ARCOMAC Surface Engineering, LLC

**in Collaboration with High Temperature Electro-Chemical
Center of Montana State University, Bozeman, Montana**

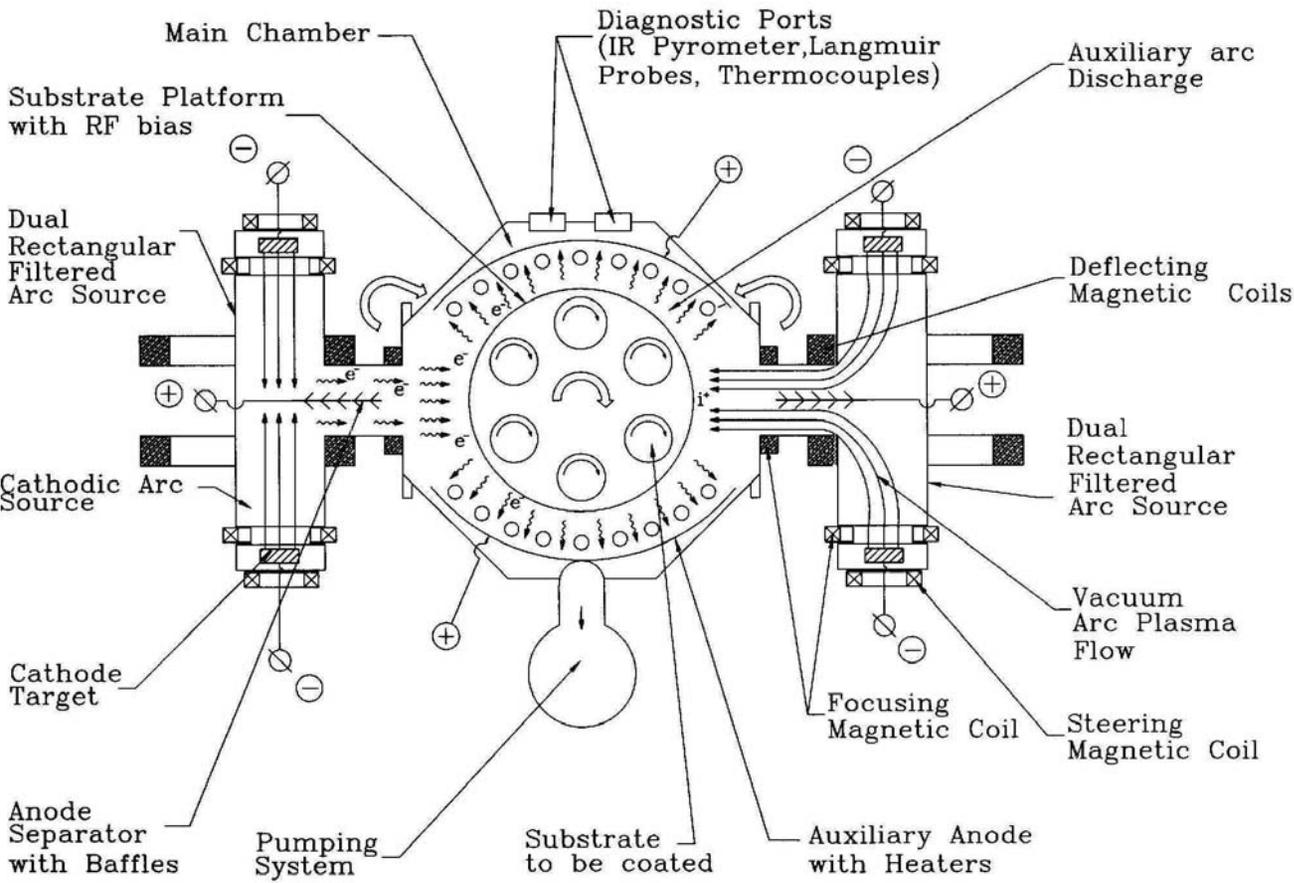
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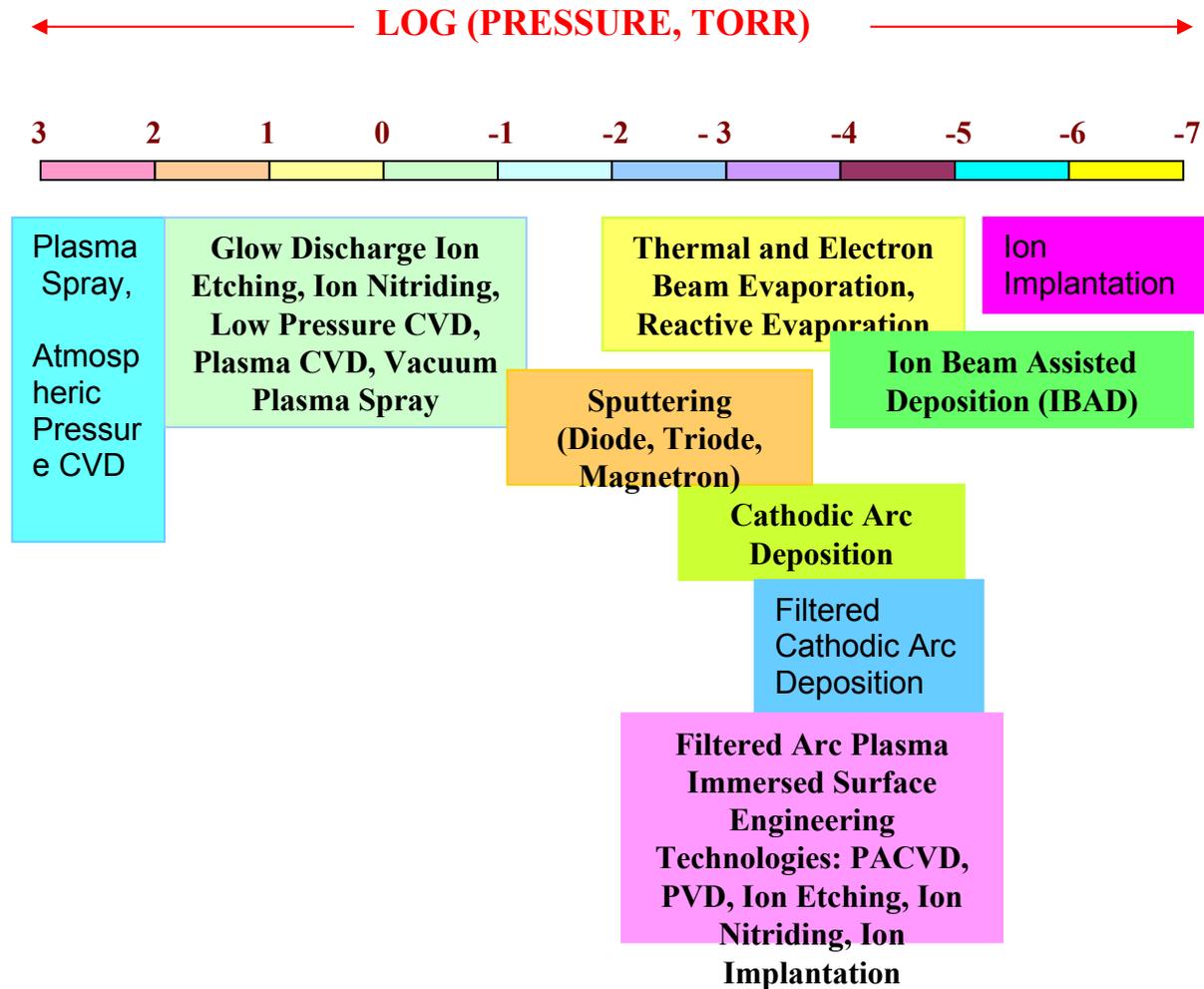
Coatings for SOFC

- Pin-hole free alumina for sealcoat
- HT corrosion resistant conductive coating for metal interconnect plates
- YSZ doped with NiO, LaO for anodes
- Doped lanthanum chromate for cathodes
- Possibility of Entire Cell Fabrication

Large Area Filtered Arc Deposition

(LAFAD™) Technology

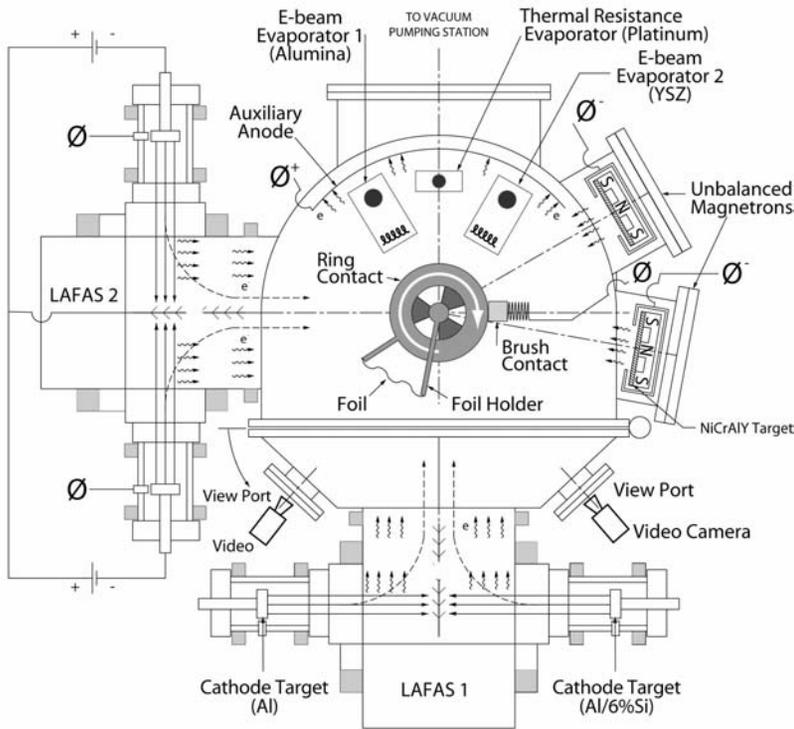




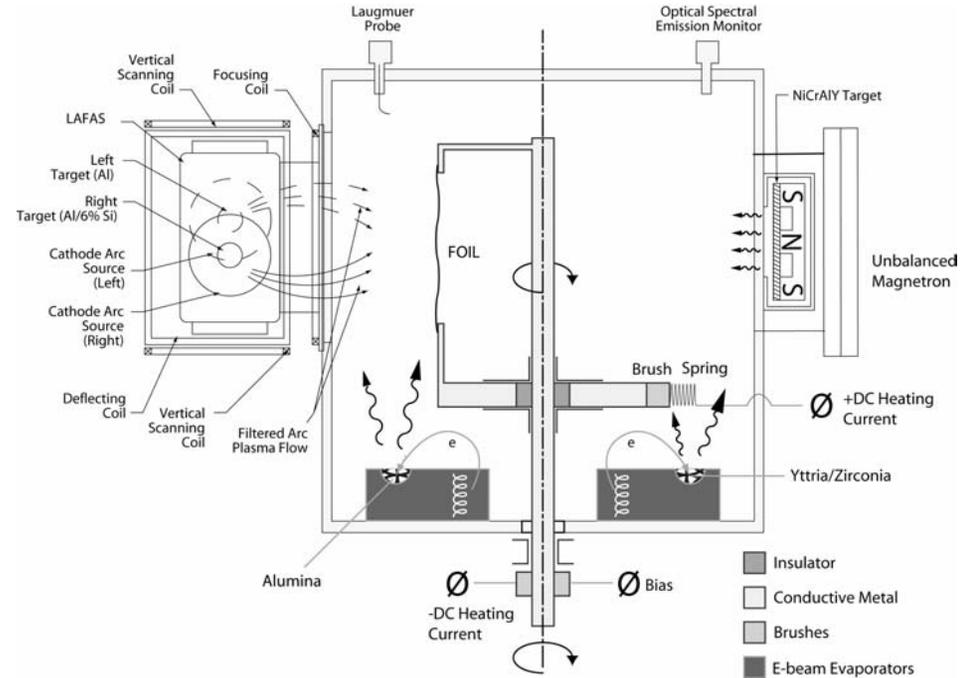
OPERATING PRESSURE RANGES FOR VARIOUS PLASMA SURFACE ENGINEERING PROCESSES

Filtered Arc Plasma Source Ion Deposition (FAPSID) Surface Engineering System

(a)- top view

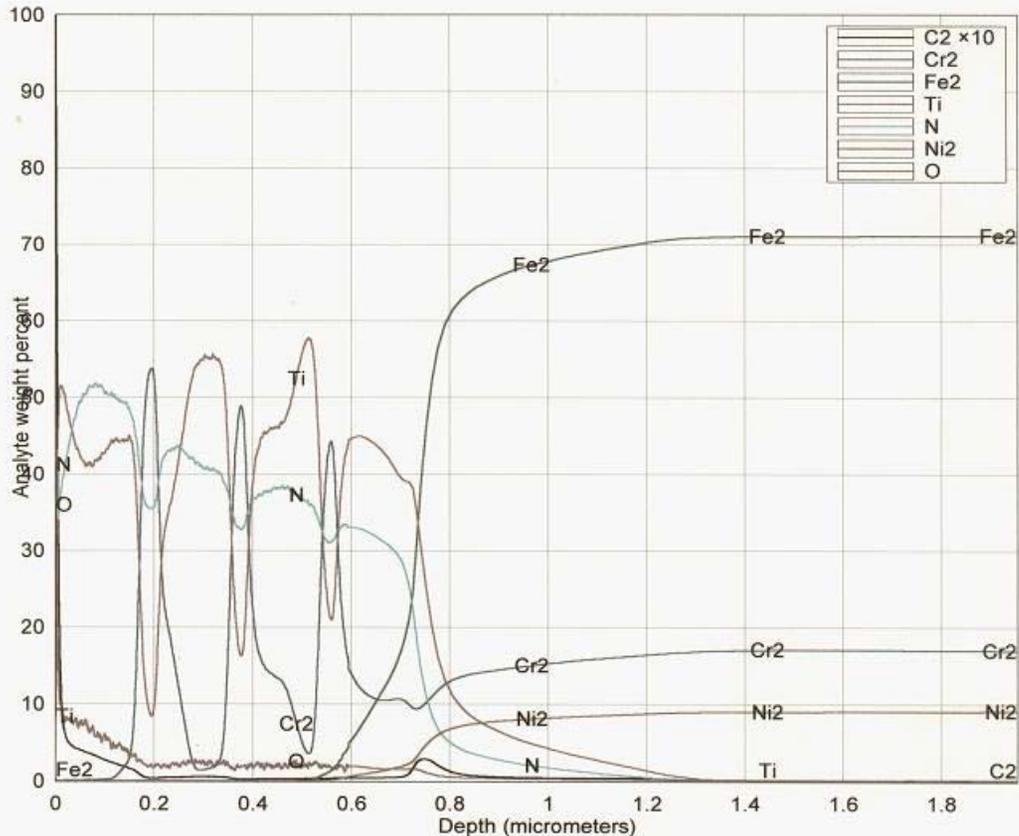


(b)- side view

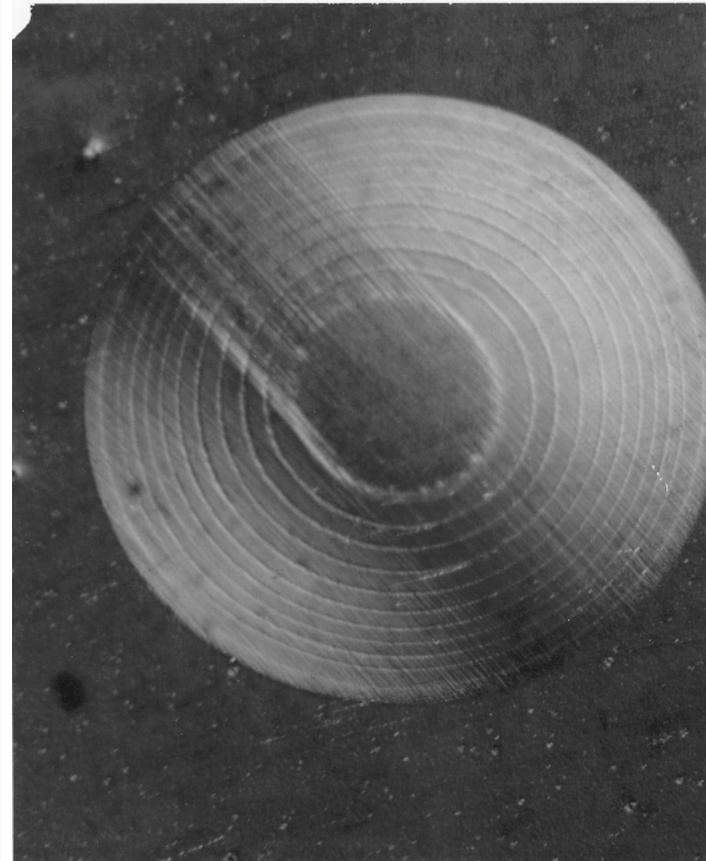


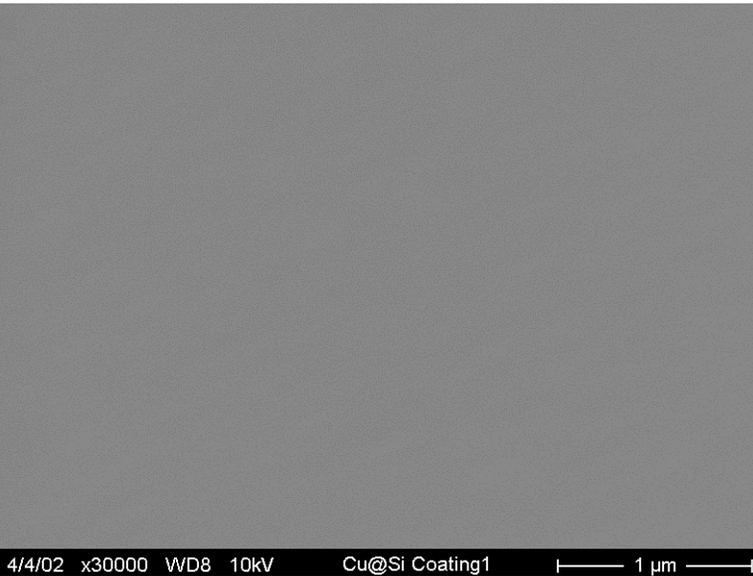
Schematic Illustration of Arcomac™ FAPSID Surface Engineering System, Utilizing Large Area Filtered Arc Sources (LAFAS) in Universal Hybride Layout with Conventional PVD sources.

**CrN/TiN MULTILAYER
GLOW-DISCHARGE OPTICAL EMISSION
SPECTROSCOPY**

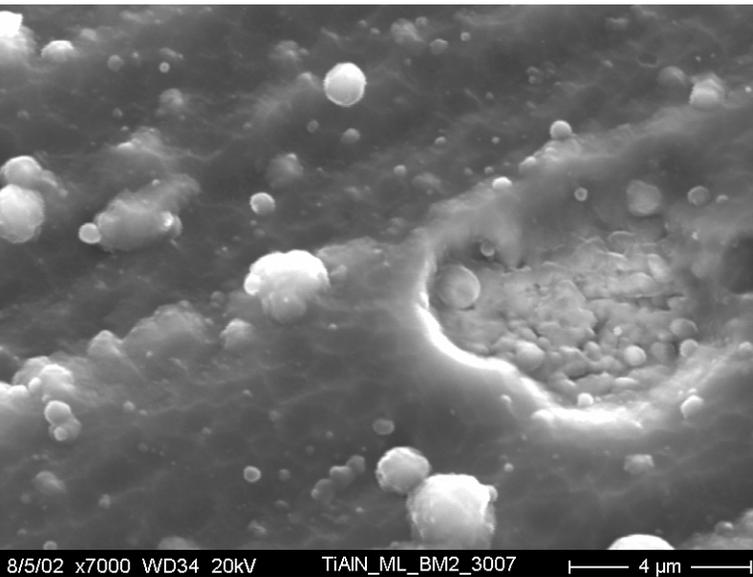
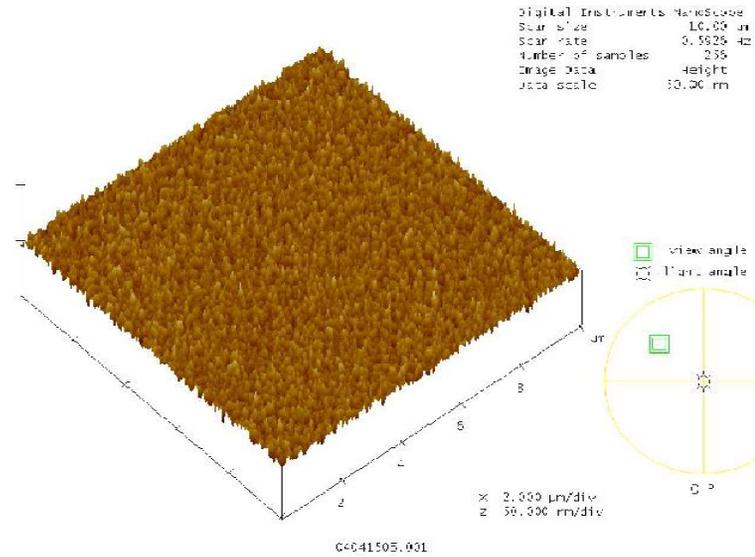


**TiN/Ti MULTILAYER
(WEAR-SCAR TEST)**





ARCOMAC™
Copper over Silicon

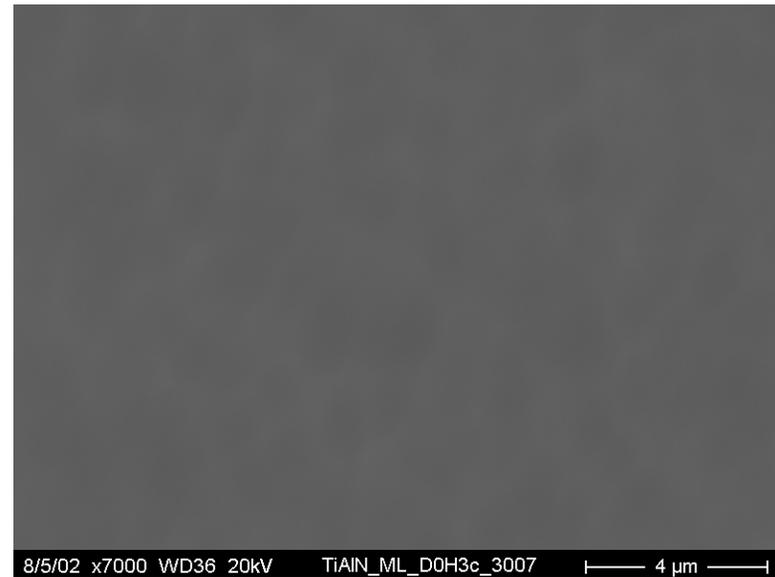


CONVENTIONAL (KENNAMETAL)

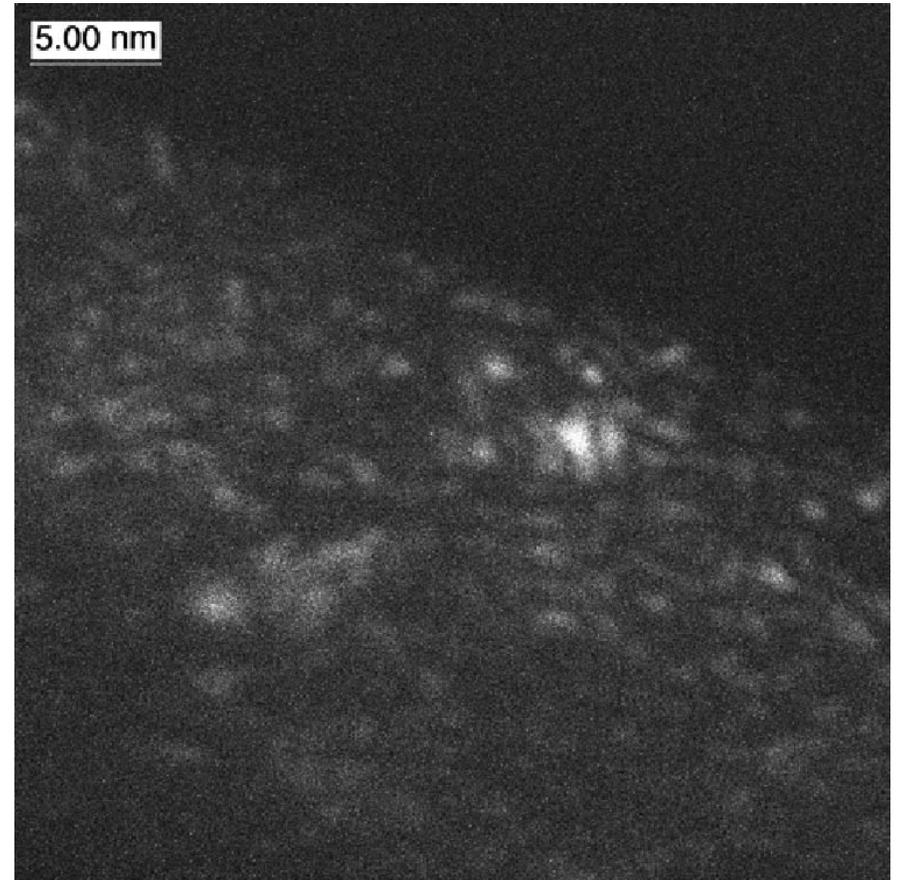
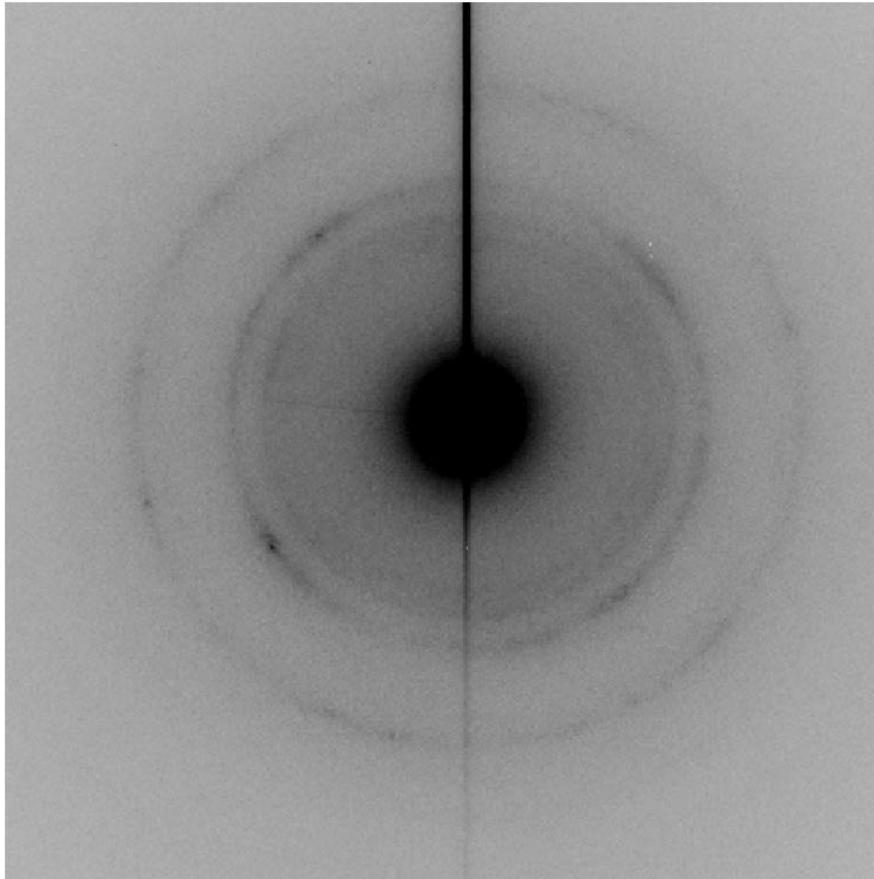


TiAlN

ARCOMAC™

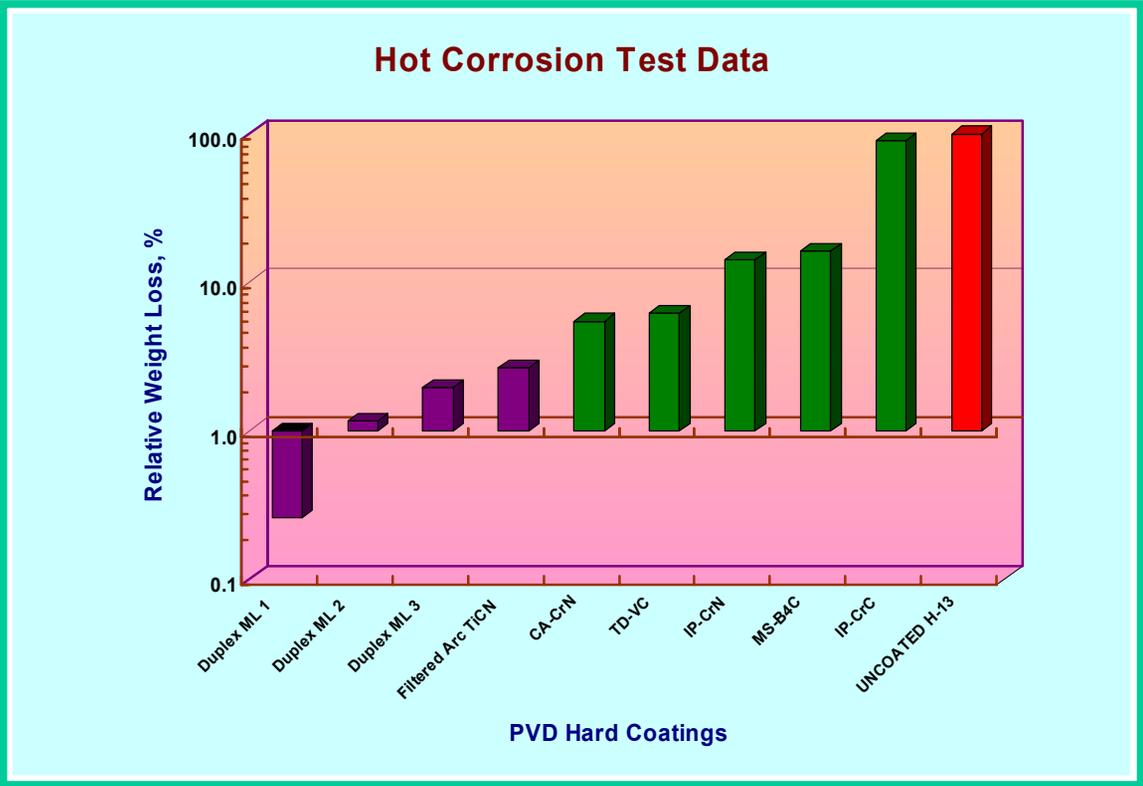
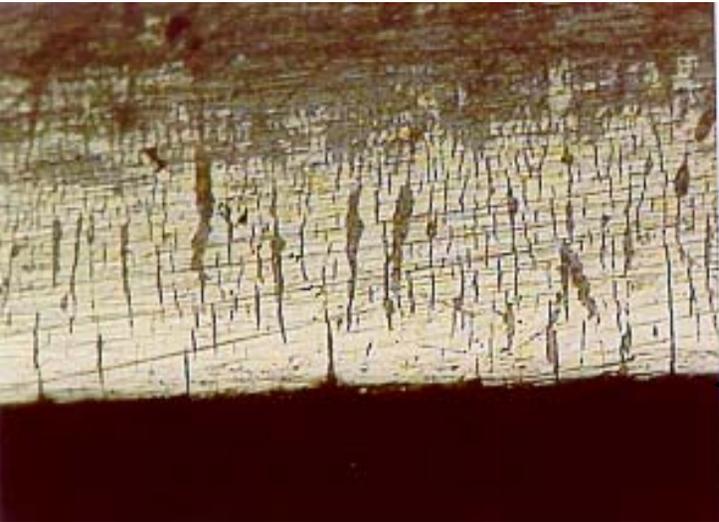
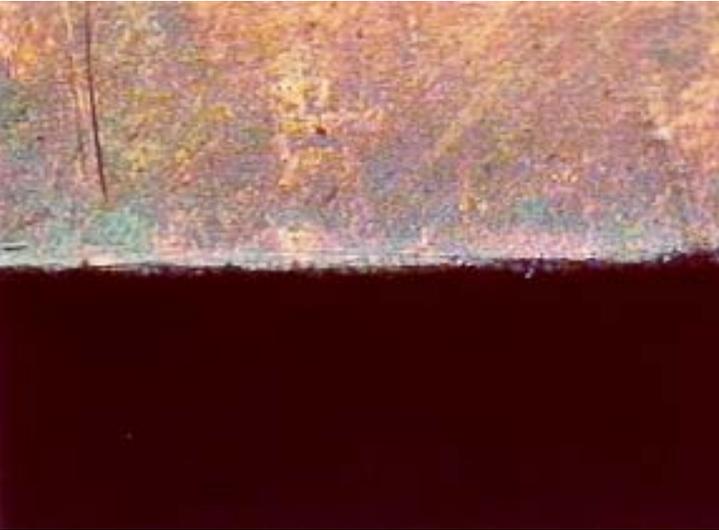


NANOCRYSTALLINE TiAlN COATING WITH SIZE OF GRAINS 1 NM
(Courtesy of Dr. David Gelles, PNNL, Richland WA)



5000 Cycles Thermal Fatigue Test

ARCOMAC MULTILAYER TiBCN/TiCN COATING

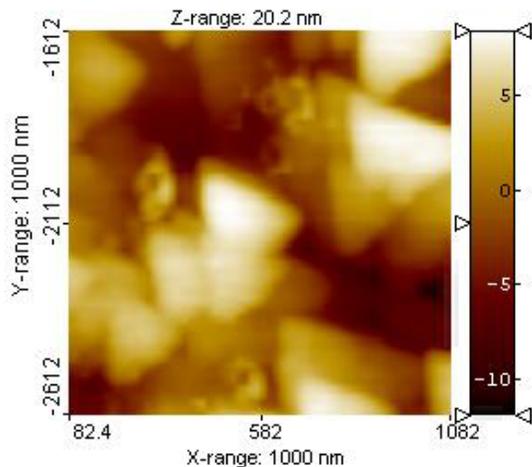


UNCOATED H-13 STEEL

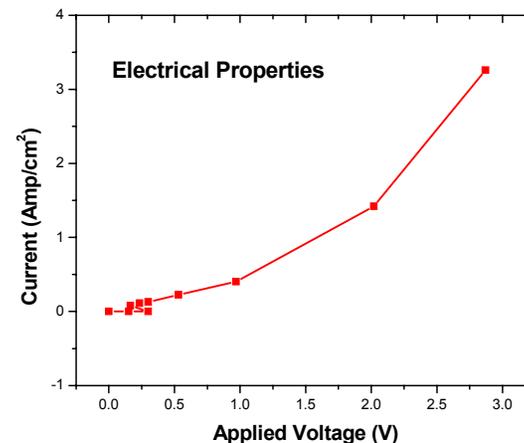
Courtesy of Prof. R. Shivpuri, Ohio State University, Columbus, OH

Corrosion resistant, electrically conducting coatings for interconnects in SOFC using Filtered Arc Deposition Technology

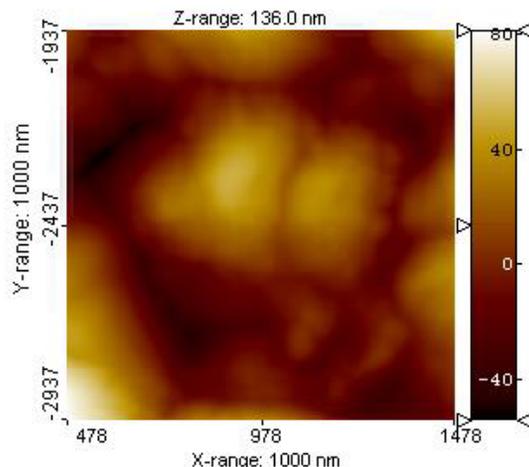
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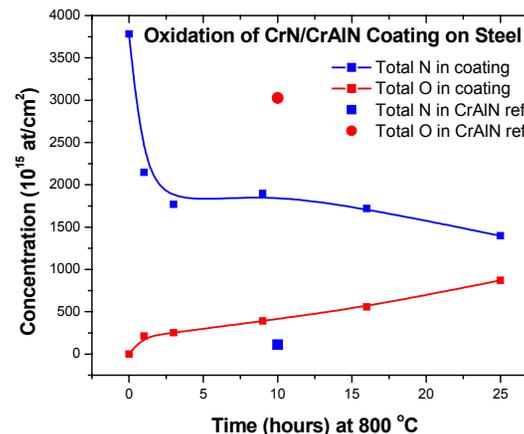
Coatings: FAD by Arcomac Surface Engineering
Measurements: R.J. Smith, Montana State Univ. at PNNL, Richland WA



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AFM 1000nm
Top: CrAlN reference sample
Bottom: CrN/CrAlN multilayer
10 hr @ 800 °C



SUMMARY

- Large Area Filtered Arc Technology is available to provide defectless pin-hole free coatings over large surface areas in a cost effective manner
- Multilayer and nanostructure coating architectures
- HT corrosion resistant conductive coatings for metal interconnect plates operating over a wide temperature range in a hostile environment
- Low cost material sets in replacement of exotic materials
- Provide for low cost manufacturing processes
- Possibility of Entire Cell Fabrication
- We want to be part of your technology team to help to get your \$/kW cost down and your ease of manufacturing SOFC improved