

# International Advanced Research Centre for Powder Metallurgy & New Materials (ARCI)

Balapur P.O., Hyderabad – 500005, Telangana, India



## Hybrid Precursor Powder Plasma Spray Technology

### Overview

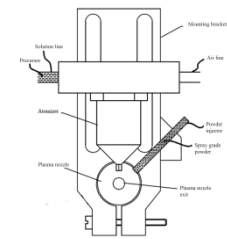
Hybrid processing involves depositing layered or composite coating architecture using sequential or simultaneous feeding of powder and liquid feedstock, respectively. Independently controlled micron sized powder feedstock and liquid precursor solution are fed into the plasma spray plume to form the desired coatings. The concept is extremely convenient to adopt, as it involves only a minor modification in the injection arrangement in any existing thermal spray facility.

### Key Features

The concept of hybrid processing opens up possibilities for depositing coatings with diverse architecture

- Layered coatings by sequential feeding of liquid and powder feedstock
- Composite coatings by simultaneous feeding of liquid and powder feedstock
- Graded coatings by simultaneous feeding of liquid and powder feedstock, while continuously varying the feed rates of one or both feedstock.

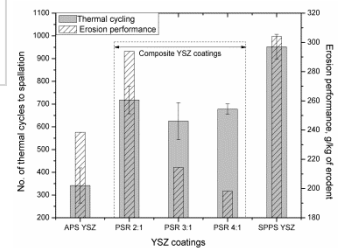
In each of the above cases, use of a liquid feedstock leads to splats that are nearly two orders of magnitude smaller than the splats from conventional thermal spray. Thus, a very unique combination of fine-coarse microstructure, not typically realizable using conventional thermal spray routes, is possible.



Schematic of hybrid APS+SPPS process

### Potential Applications

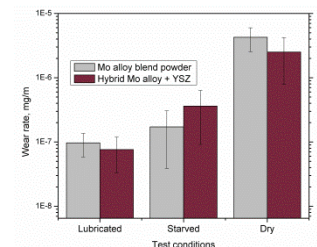
- Composite YSZ based TBCs for gas/steam turbine applications
- Composite alloy/metallic + ceramic coatings for wear resistance
- Oxide dispersed coatings for elevated temperature applications



Thermal cycling and erosion performance of composite YSZ coating

### Intellectual Property Development Indices (IPDI)

- Developed wide ranging functional coatings for diverse industrial applications
- Prototype demonstration of various coatings is in progress



Wear performance of nanocomposite Mo alloy + YSZ coating

Status	1	2	3	4	5	6	7	8	9	10
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### Major Patents / Publications

- G. Sivakumar and S.V. Joshi, 'An improved hybrid methodology for producing composite, multi-layered and graded coatings by plasma spraying utilizing powder and solution precursor feedstock', Indian Pat. No. 2965/DEL/2011 dt. 17<sup>th</sup> Oct, 2011
- A. Lohia, G. Sivakumar, M. Ramakrishna and S.V. Joshi, "Deposition of Nanocomposite Coatings employing a Hybrid APS + SPPS Technique", Journal of Thermal Spray Technology, 23(7), 1054-1064, 2014
- S.V. Joshi and G. Sivakumar, Hybrid processing with powders and solutions: A novel approach to deposit composite coatings, Journal of Thermal Spray Technology, 24 (7), pp. 1166-1186, 2015

### Centre for Engineered Coatings (CEC)

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