

Traitements de Surface pour l'Érosion par l'Eau Water Erosion Surface Treatments

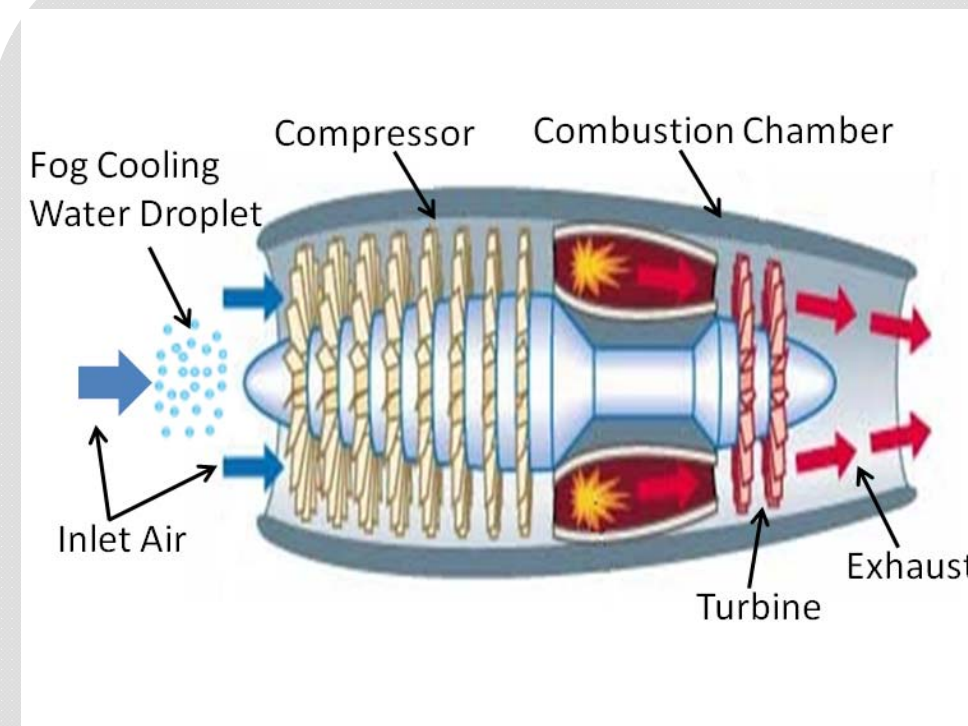
W. Chen¹, M. Najafi¹, N. Kamkar², E. Billot³, D. Ma¹, M. Mahdipoor¹, M. Panjan³,

A. Dolatabadi¹, M. Medraj¹, P. Bocher², F. Bridier², J. Sapiha³, O. Zabeida³, P. Jedrzejowski⁴

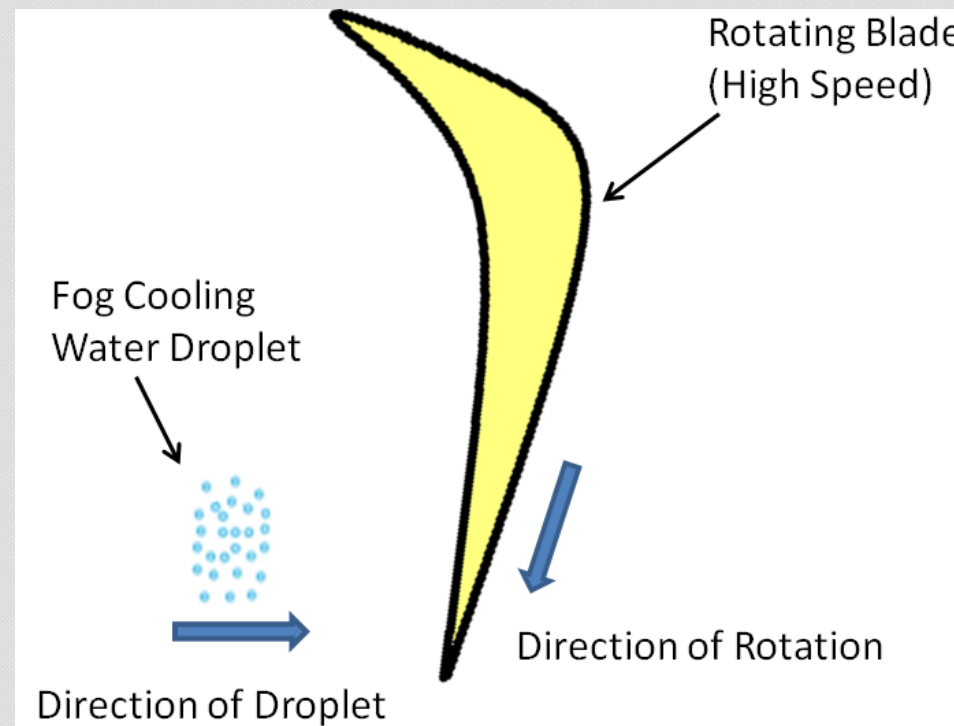
¹Concordia University, ²École de Technologie Supérieure, ³École Polytechnique de Montréal, ⁴Rolls-Royce Canada

Origin of the Project:

Cooling water droplets severely impact the surfaces of the compressor blades that in long term can lead to a deterioration of a turbine efficiency.



Gas Turbine and Inlet Cooling Water Droplet



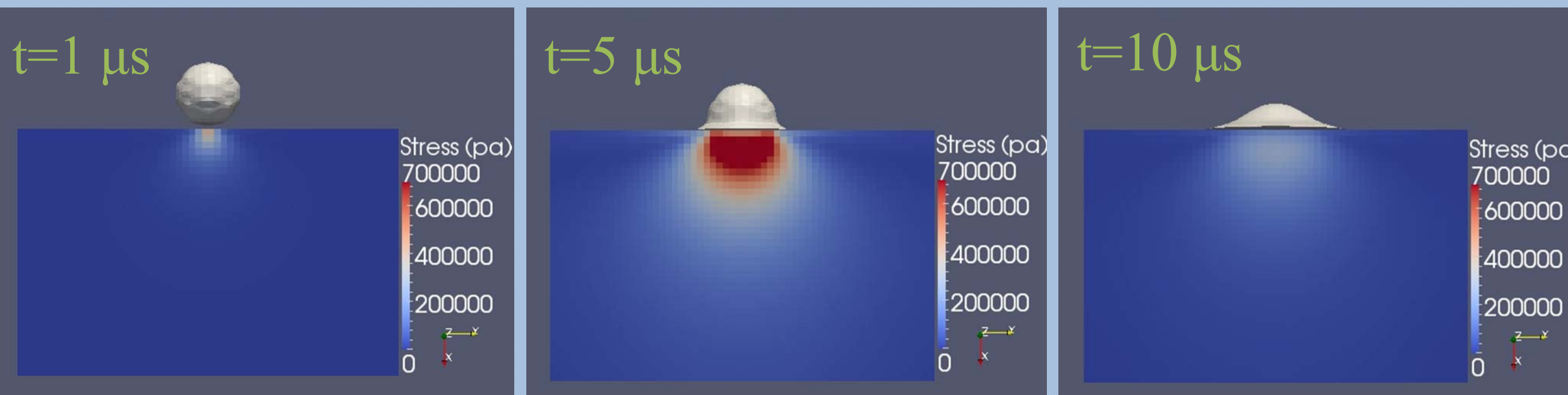
Relative Motion Between Droplets and Rotor Blades



Real Blades Damage via Water Droplet Erosion [Reference: EPRI Report 2008]

Illustration of Water Droplet Erosion to Turbine Rotor Blades and Real Damage

Droplet Impingement Modeling (Concordia)



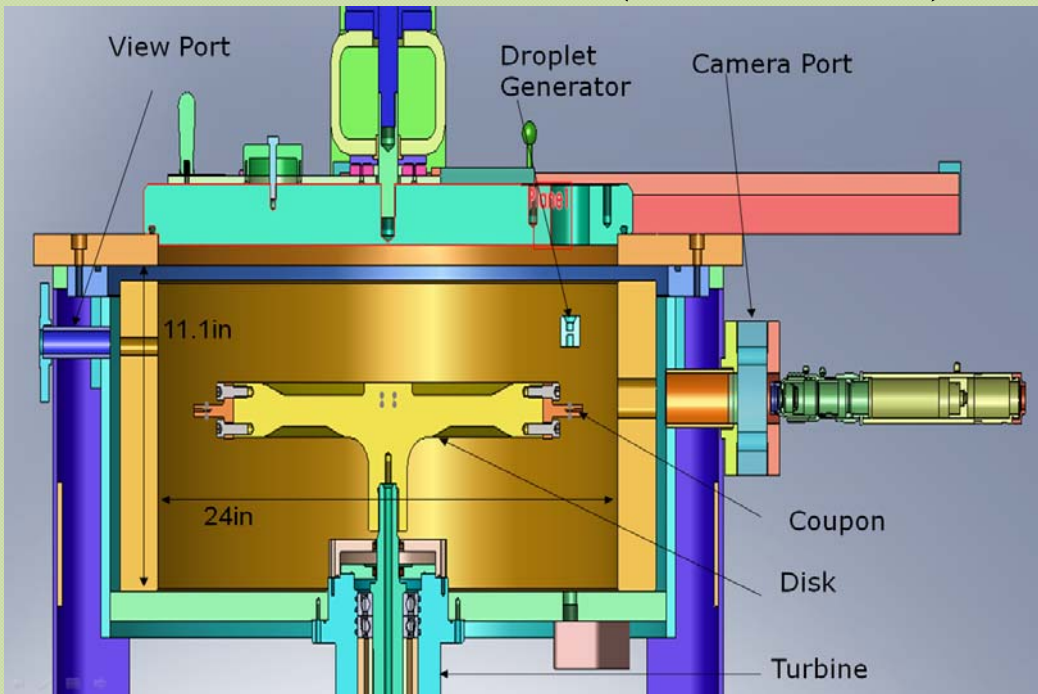
Evolution of a 0.5-mm droplet impacting a 2.5-mm SS substrate with impact velocity of 40 m/s along with the stress in the solid shown in color. The impact time is 1μs, 5μs and 10μs.

Methodology:

Key issues to understand water erosion process and improve the resistance:

- 1) Droplet impingement modeling,
- 2) Failure Analysis,
- 3) Coating and surface treatment,
- 4) RIG that can replicate the real droplet impingement.

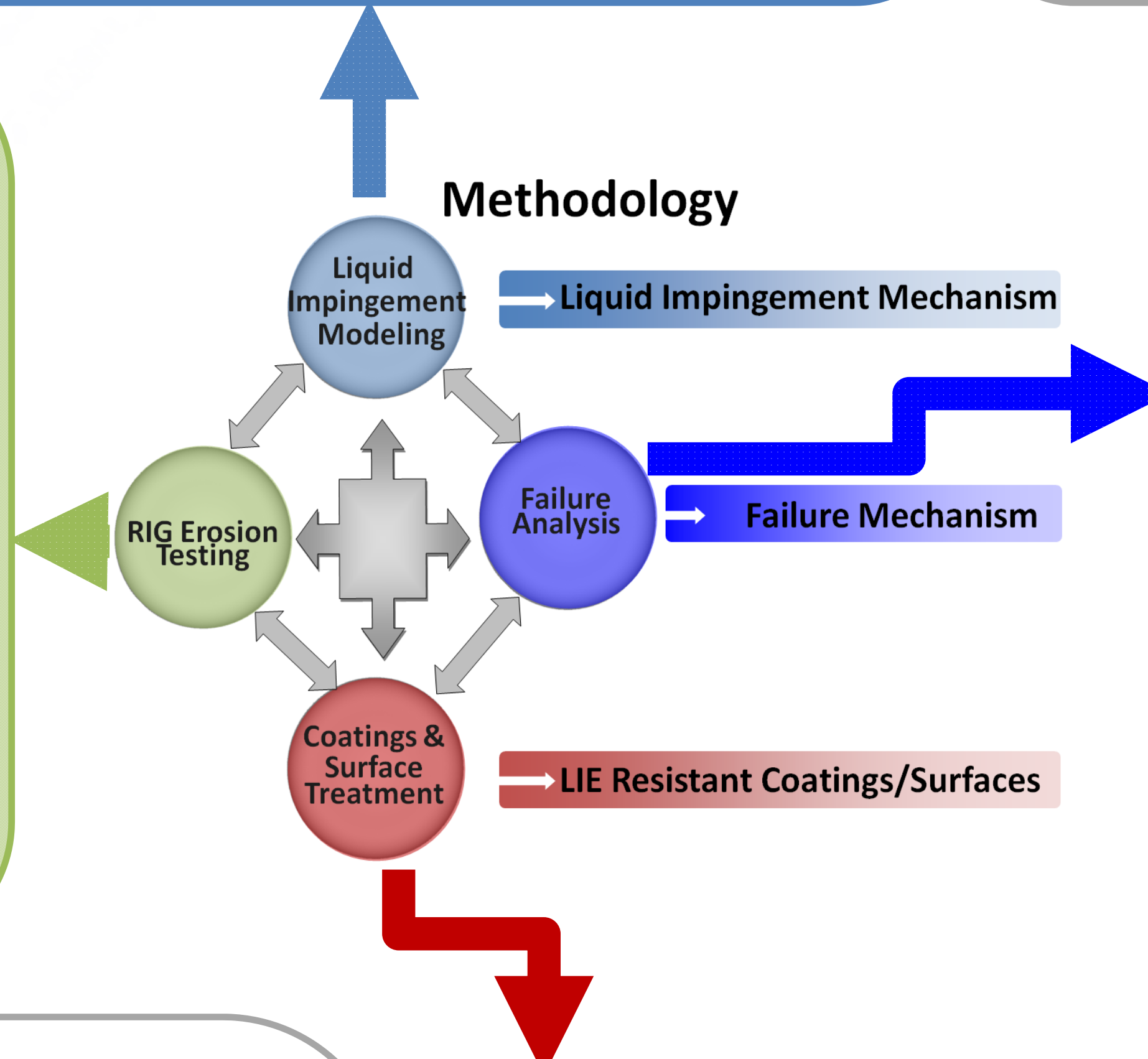
Water Erosion RIG (Concordia)



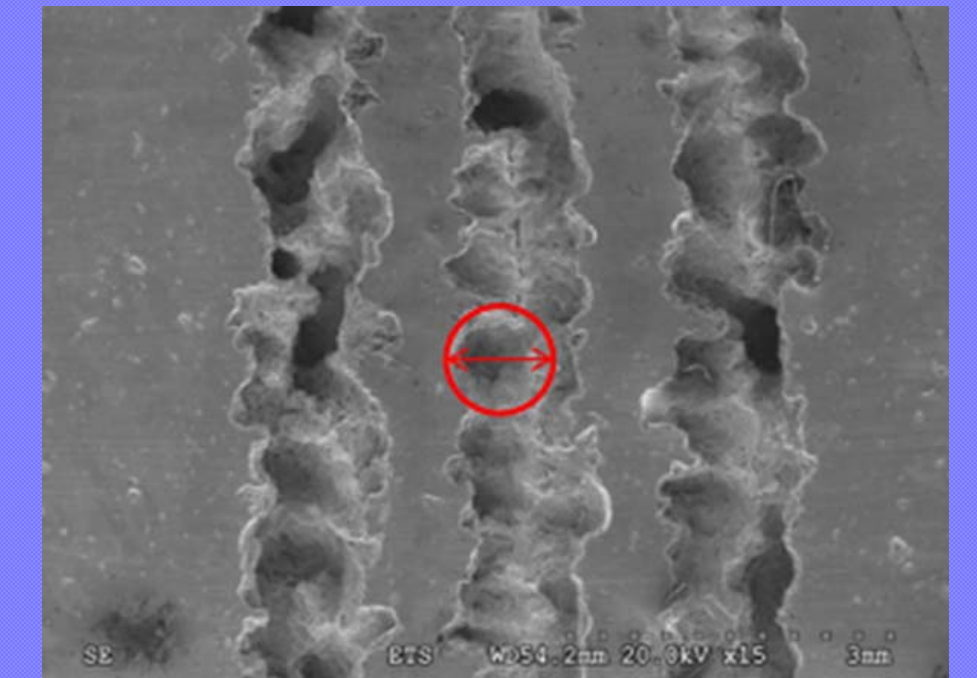
Specifications & Advantages:

- * Rotating speed: up to 500 m/s
- * Controlled droplets size distribution
- * Drops generating mode: as a conical spray and as streaks of separated drops.
- * Imaging: high speed camera

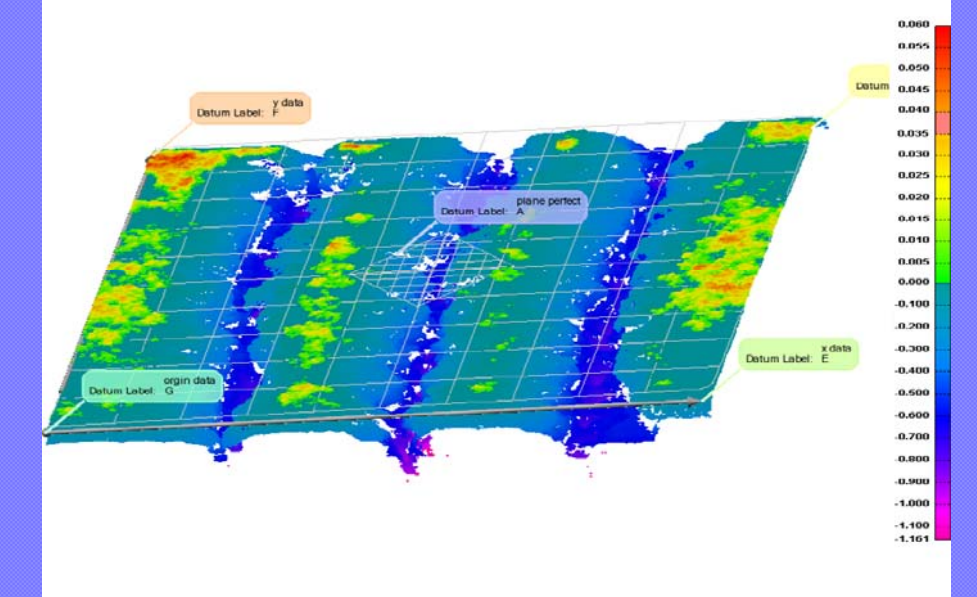
Methodology



Failure Analysis (ETS)



SEM image of eroded surface

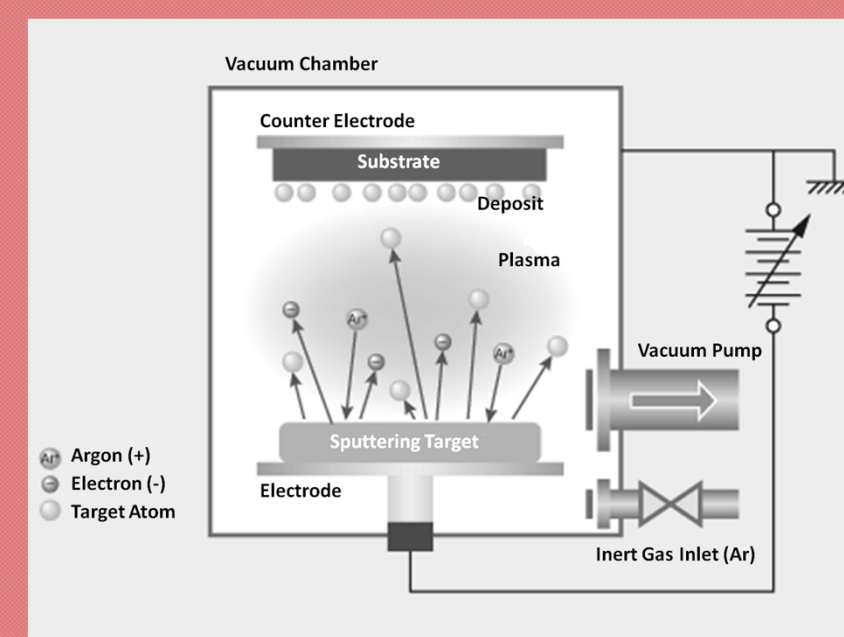


3-D image of eroded surface

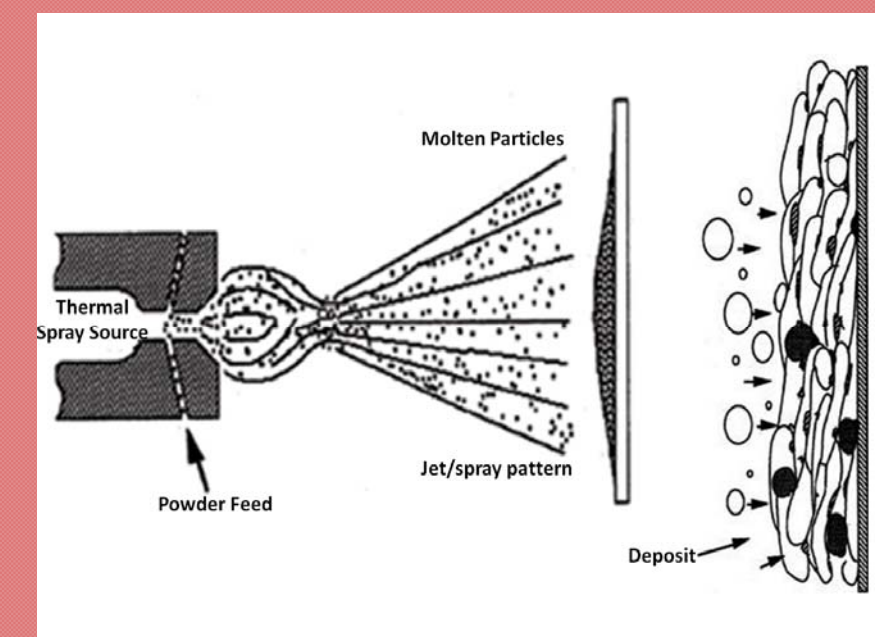
Main Progresses:

- 1) Liquid droplet impingement modeling upon variable droplet size, substrate, and impact speed. Stress distribution evolution in the solid can be calculated by the model.
- 2) Failure analysis indicates the penetration mechanism of water erosion.
- 3) Samples were prepared through different techniques: laser shock peening, laser nitriding, boronizing, in-situ reaction, etc.
- 4) Water erosion RIG will be put into use soon, which may further validate the model and test the sample properties.

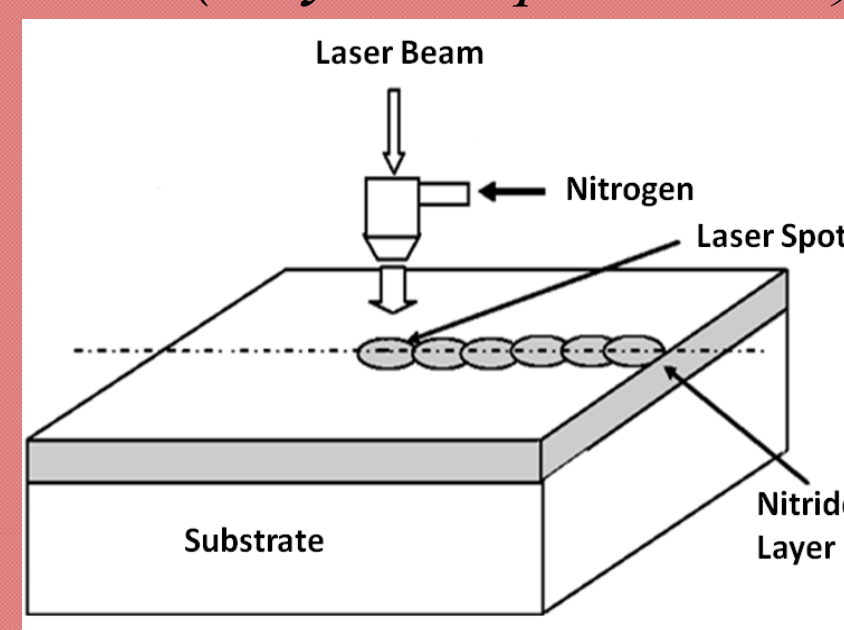
Different Coating/Surface Treatment Processes



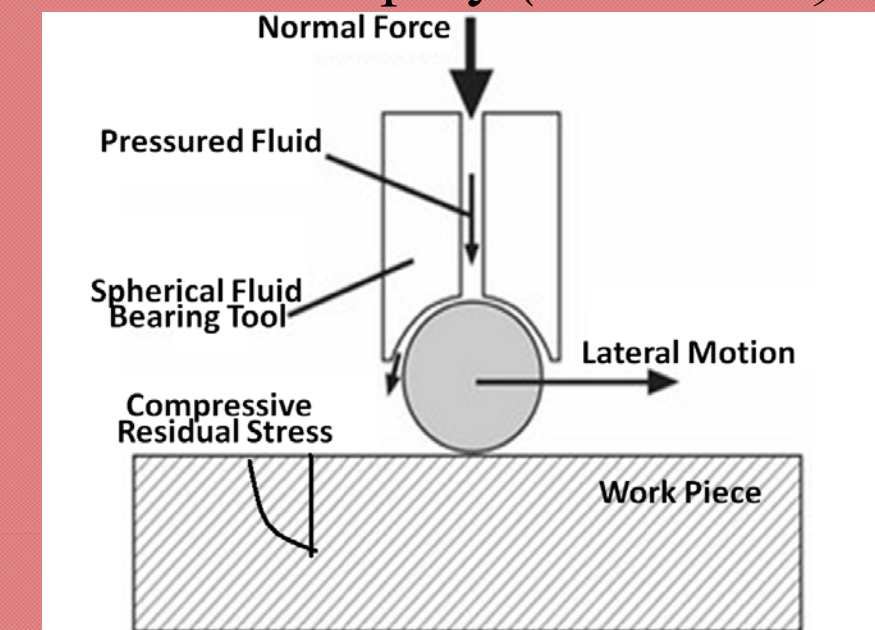
PVD (Polytechnique & PATT)



Thermal spray (Concordia)



Laser nitriding



Low plastic burnishing (Concordia)

PARTENAIRE / PARTNERS

