Laboratoire d'Optimisation des Procédés de Fabrication en Aéronautique

ÉTS
Le génie pour l'industrie

Tuesday, February 19th 2013

CRIAQ MANU419 project meeting :

"Water droplets erosion mechanims of Ti-alloys used for gas turbine compressor"

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NSERC CRSNG

Rolls-Royce

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Philippe Bocher

Objectives :

1) Understanding the influence of base material (Impingement direction)
   - Characterization of blade microstructure
   - Material selection relative to the blade microstructure
   - Rig test plan

2) Understanding the influence of LSP and LPB on erosion behavior
   - Characterization of LSP and LPB samples
     - Craters width measurement
     - Crack analysis (size/Inclination)
     - Erosion features and mechanism

Highlights :

- Events :
  - Fall semester 2012 mainly spent in preparation of doctoral exam
  - Accepted article to Wear of Materials Conference & Journal

- Research work :
  - characterization of the material in order to select the appropriate material for erosion investigation
  - characterization work on eroded LPB coupons

Content

Introduction

- Context and objective of the study

I – Characterization of base materials

- Microstructure and crystallographic texture selection

II – Characterization of the LPB coupons

- Base material
- Craters size and depth
- Erosion mechanism
- Cracks measurements

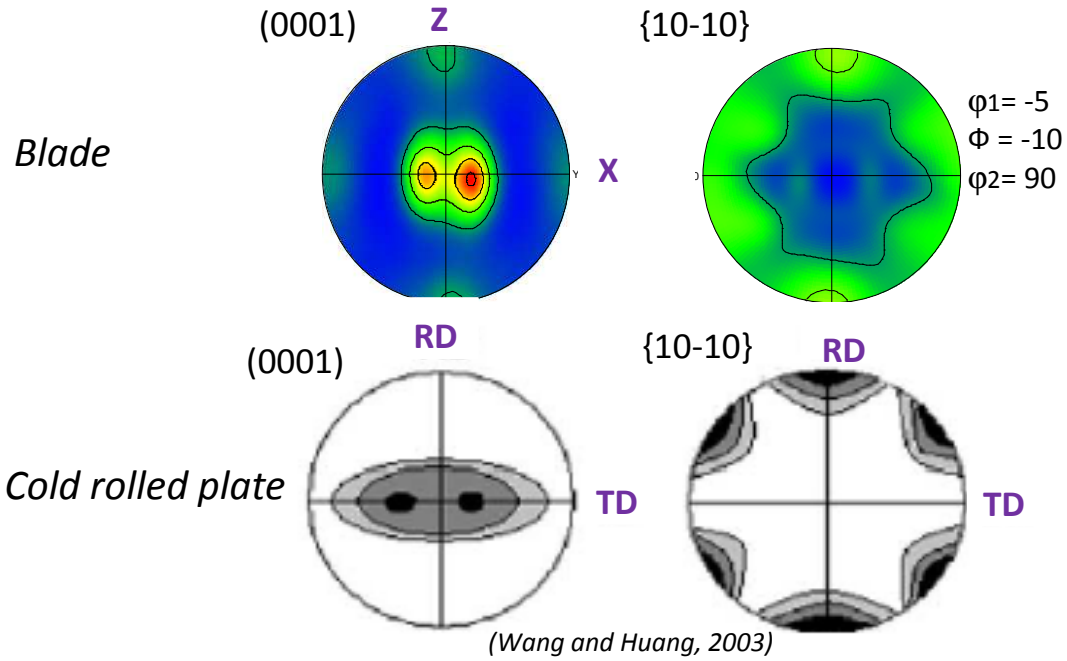
distorted picture

Part 1 -

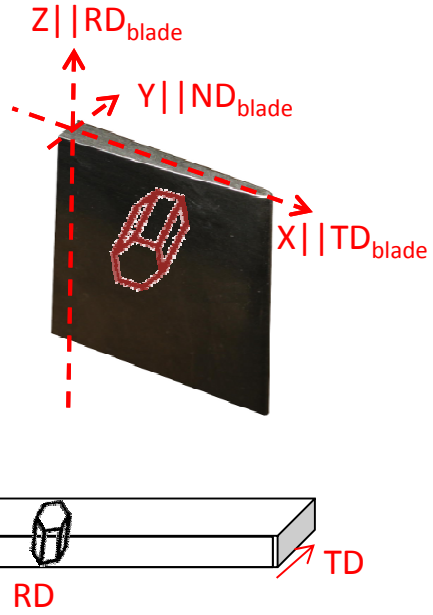
Characterization of base material

1-1 Base material selection

- Cold rolled Ti-6Al-4V texture: basal or nearly basal texture with the poles tilted up to 40° towards TD



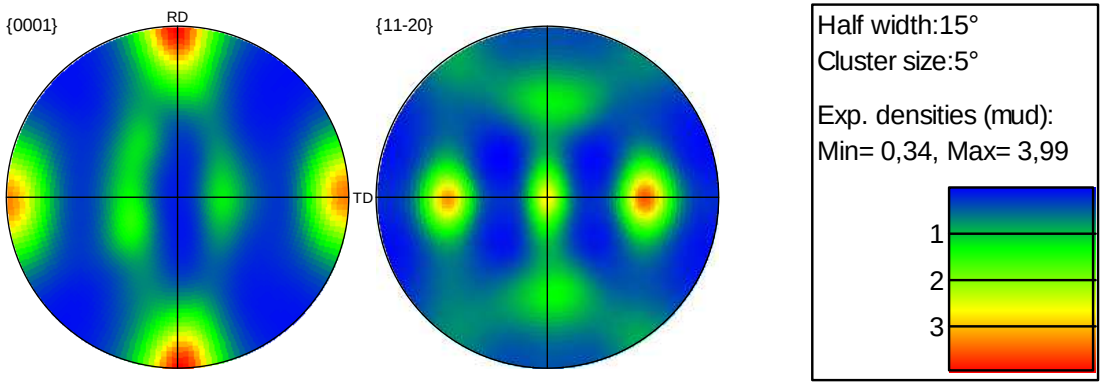
(Wang and Huang, 2003)



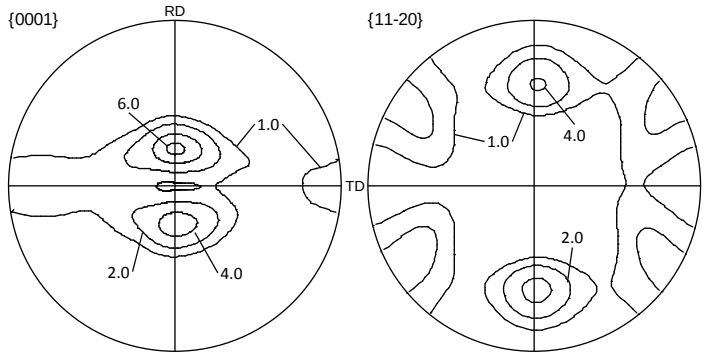
↳ Cold rolled plate is selected for base material study

1-2 Characterization of different base materials

Rolled plate from Concordia



Rolled plate/ Flat samples



Rolled plate from RR

Under progress

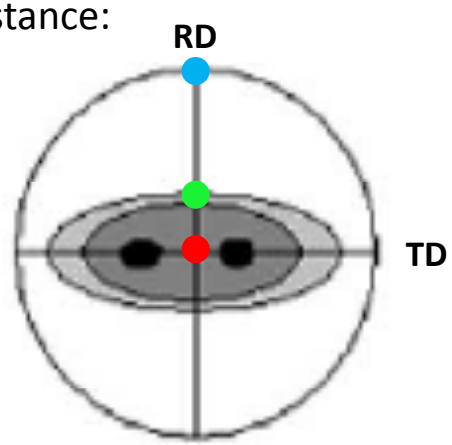
! Issue:
Finding appropriate material

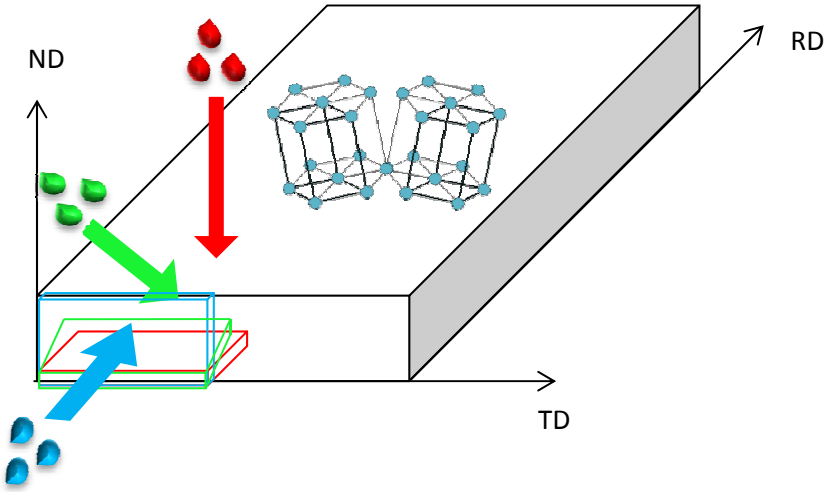
↳ Material selection will be done (February, 2013)

1-3 Near future works for impingement direction influence

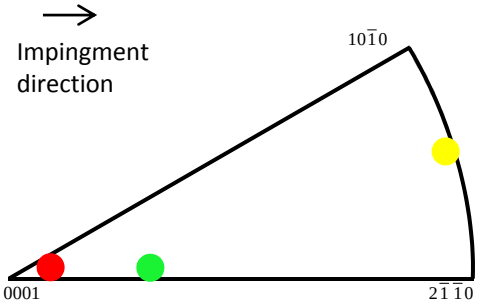
- Experimental plan to investigate influence of crystallographic texture of base material on water erosion resistance:

Pole figure





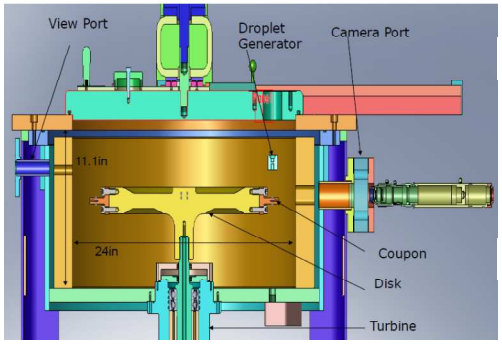
Inverse pole figure

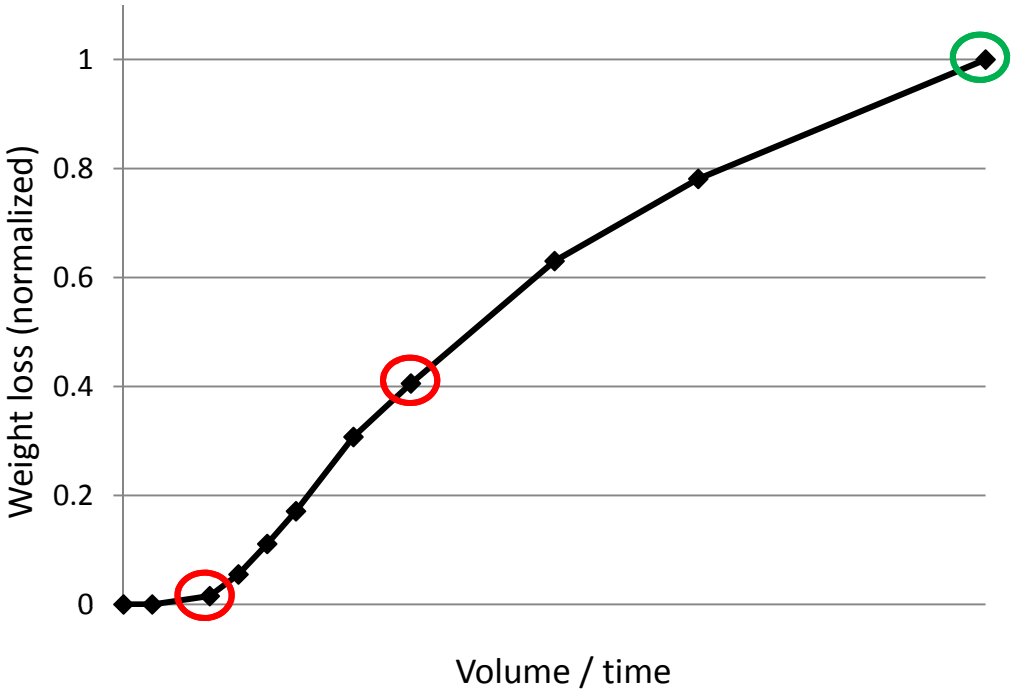


↳ different impingement directions relative to cold rolled plate

1-3 Near future works for impingement direction influence

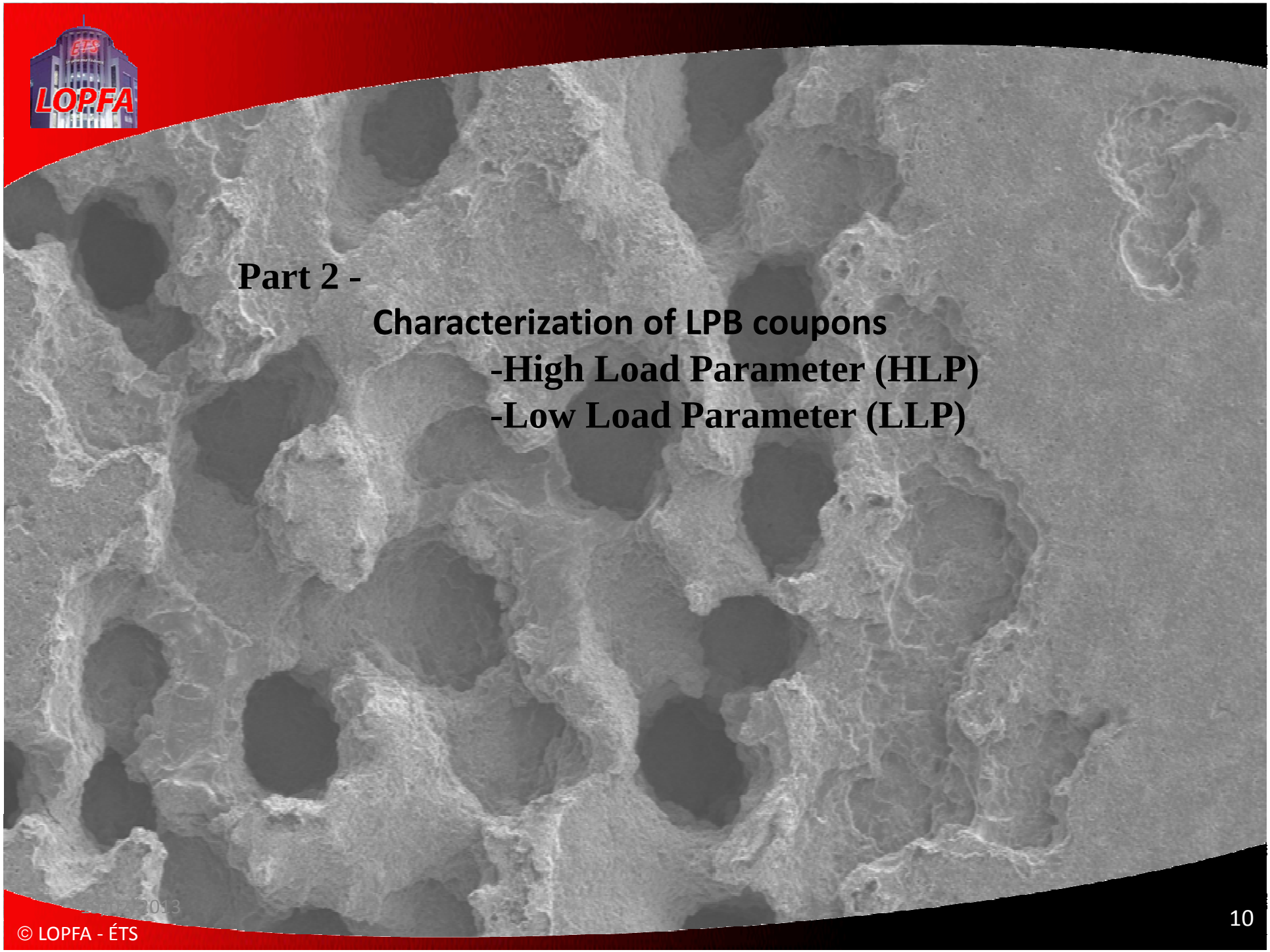
- for each direction of impingement : 3 erosion tests to be run at Concordia (march. - April. 2013)





1 test until steady state with many interruptions for weight measurement

2 other tests up to early and intermediate stages of erosion



Part 2 -

Characterization of LPB coupons

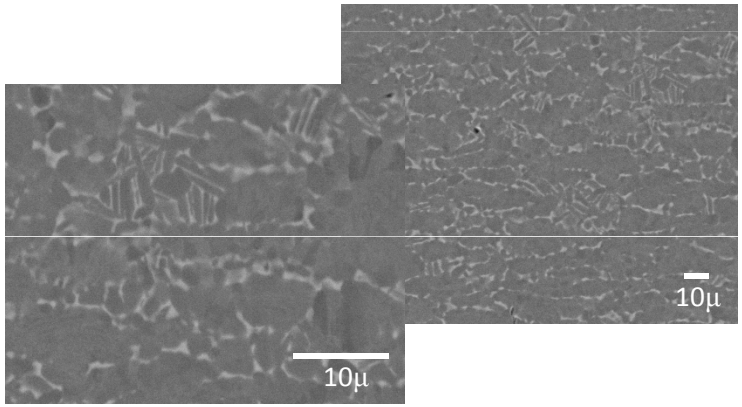
-High Load Parameter (HLP)

-Low Load Parameter (LLP)

2-1 Erosion characterization

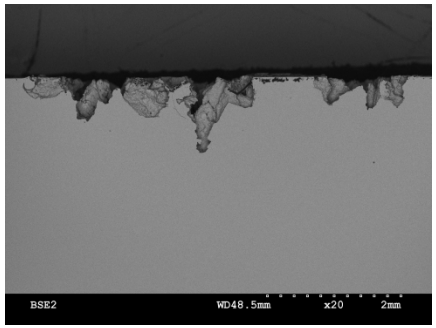
- Base material studies

  ↳ microstructure at different scale

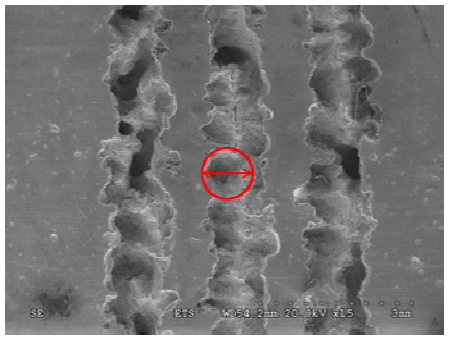


- Description of craters depth and width:

  ↳ craters formation at macroscopic scale

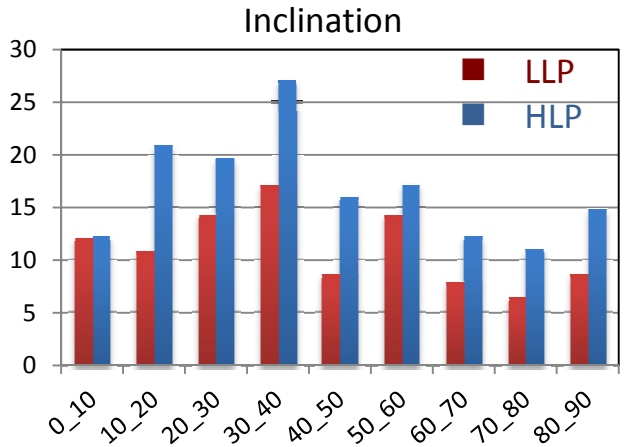


Average depth
LLP: 575 µ
HLP: 486 µ



Average width
LLP: 545 µ
HLP: 577 µ

2-1 Erosion characterization

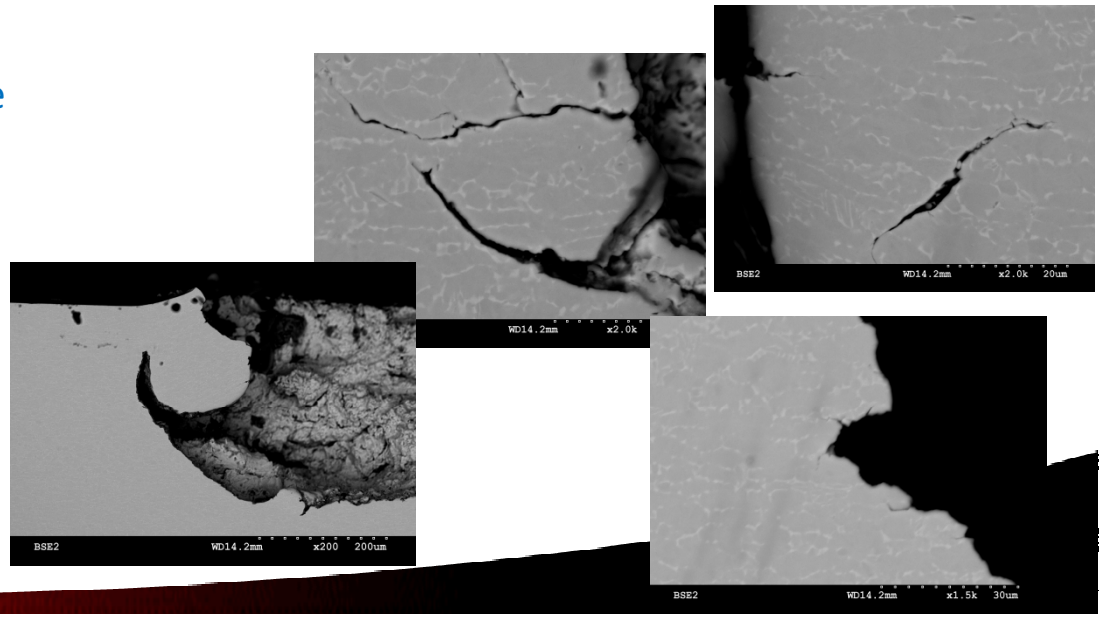


- Observation and specific preparation of cross-section of eroded coupons:

  ↳ crack size and inclination measurement

- Observation of erosion features:

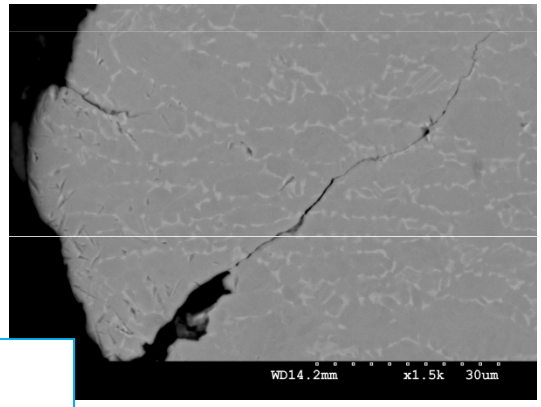
  ↳ investigation of erosion mechanism with the focus on surface treated zone



2-2 Near future work for surface treatment investigation

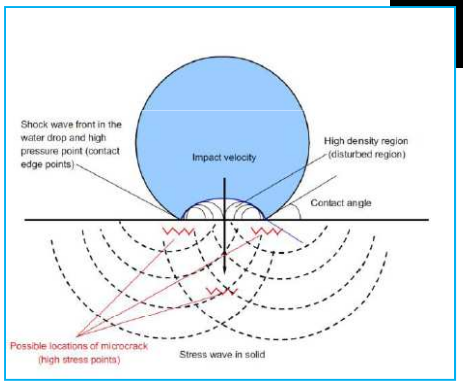
• Furture investigation on erosion features and stress field

↳ cracks and features observation
↳stress fields analysis (Collaborating with Concordia group)



• Erosion mechanisms comparison of the LSP, LPB and untreated coupons

Untreated coupons are under manufacturing and will be tested at Alstom (March-April, 2013)



Thank you.

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