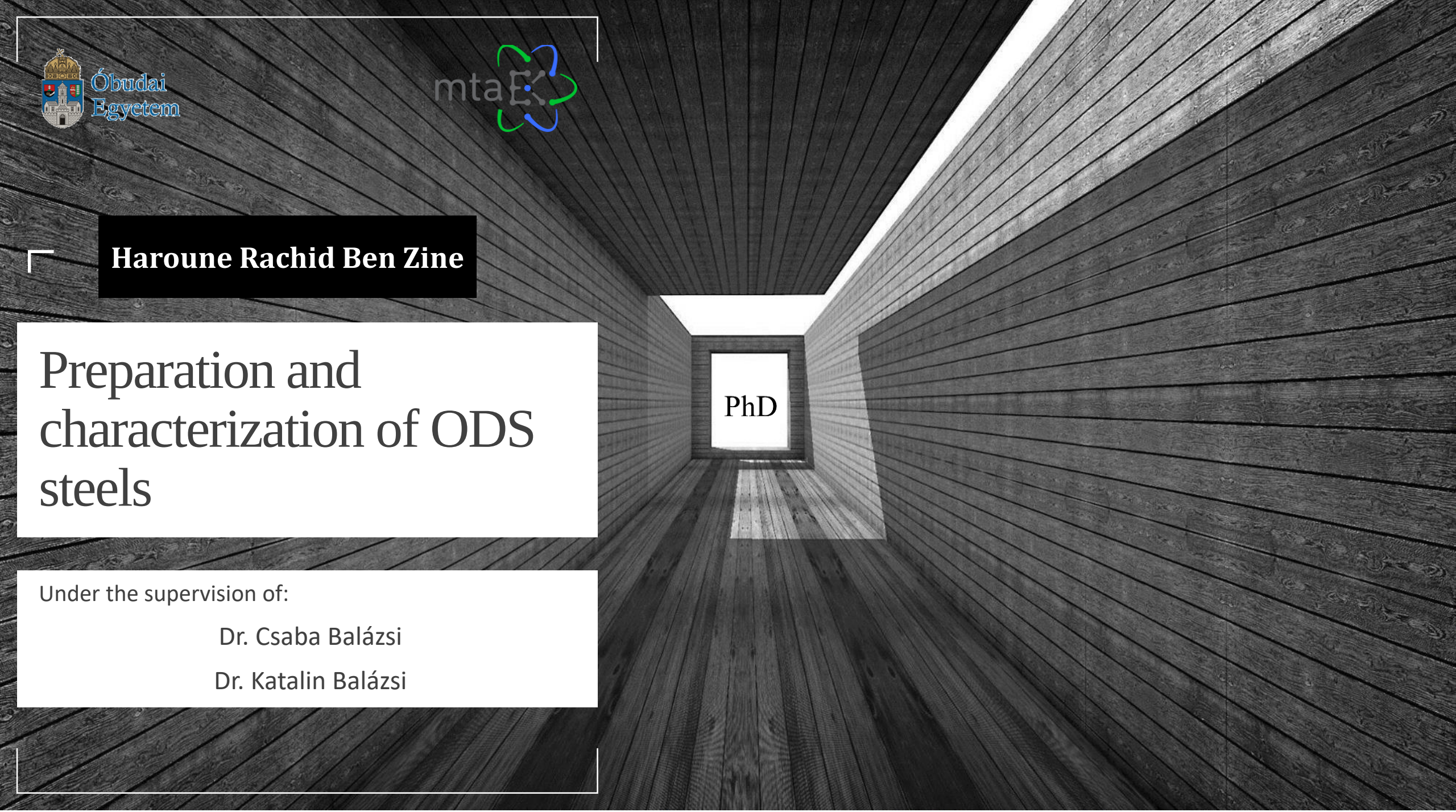


Haroune Rachid Ben Zine

Preparation and characterization of ODS steels

Under the supervision of:

Dr. Csaba Balázsi

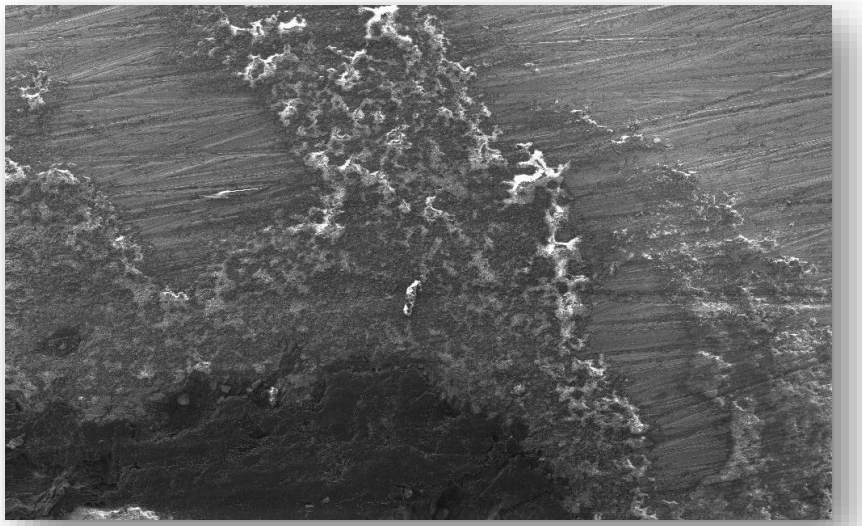
Dr. Katalin Balázsi

Content:

- Flash from the previous semester
- Actual semester experimental results:

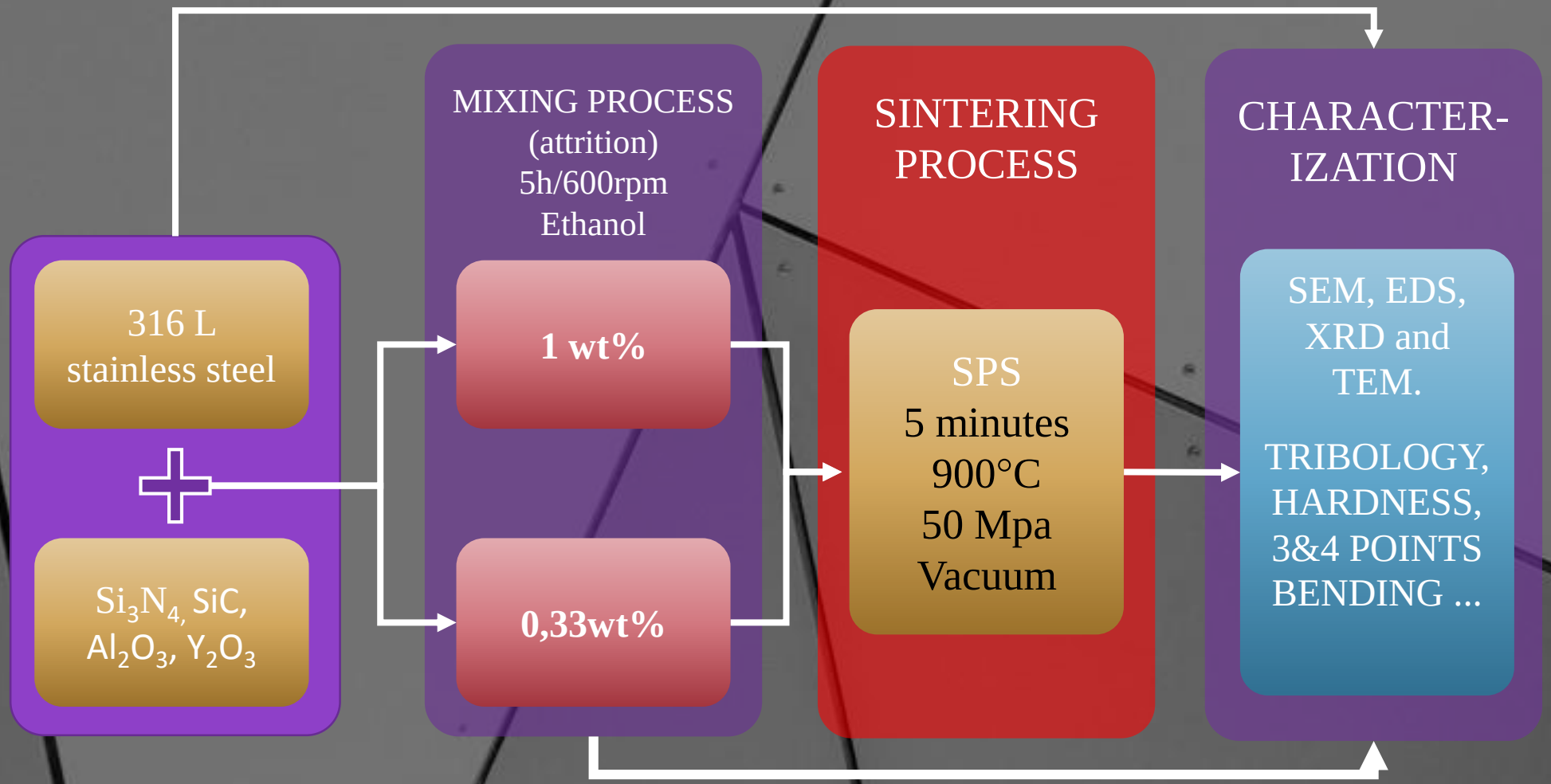
  - New results of SiC Composites
  - investigation of Y_2O_3 Composites
  - investigation of the Al_2O_3 Composites
  - results comparison of the produced 316L/ceramic (CDS) composites

- Summary of the Actual semester

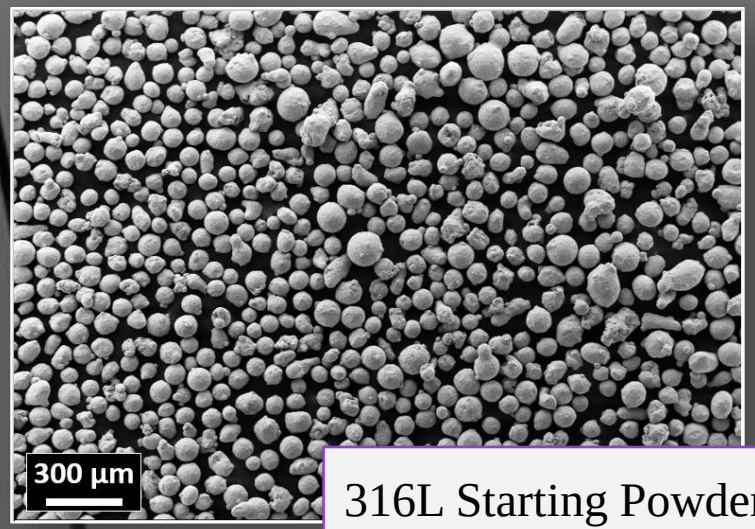


Flash from the previous semester

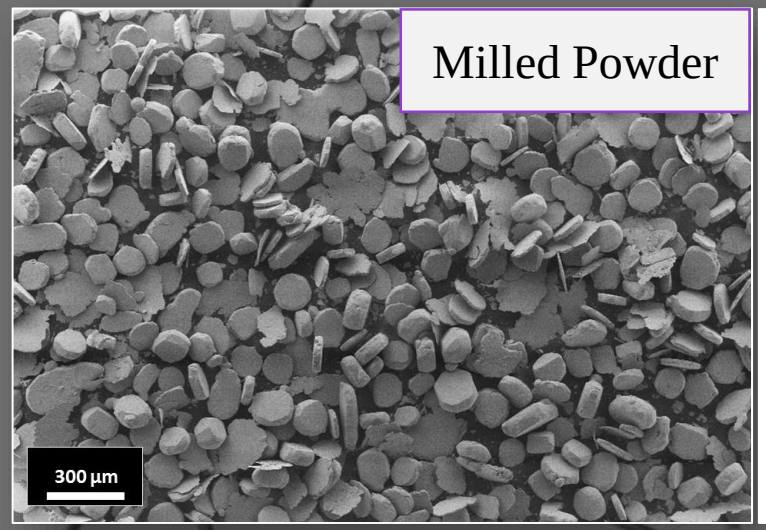
Flash from the previous semester



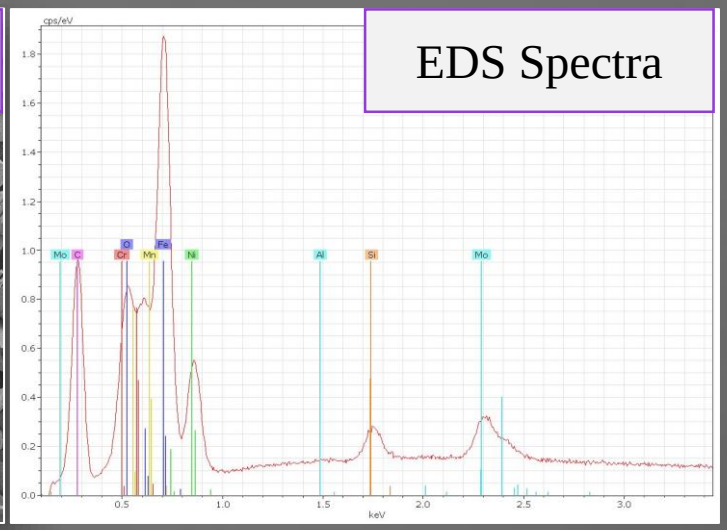
316L reference



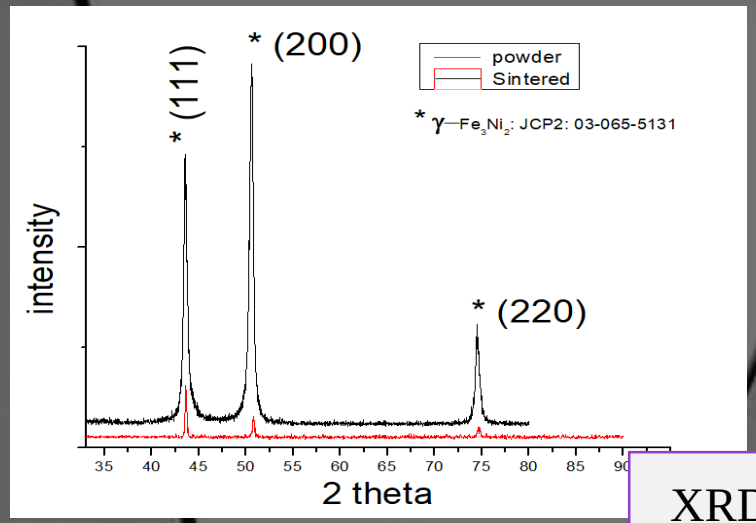
316L Starting Powder



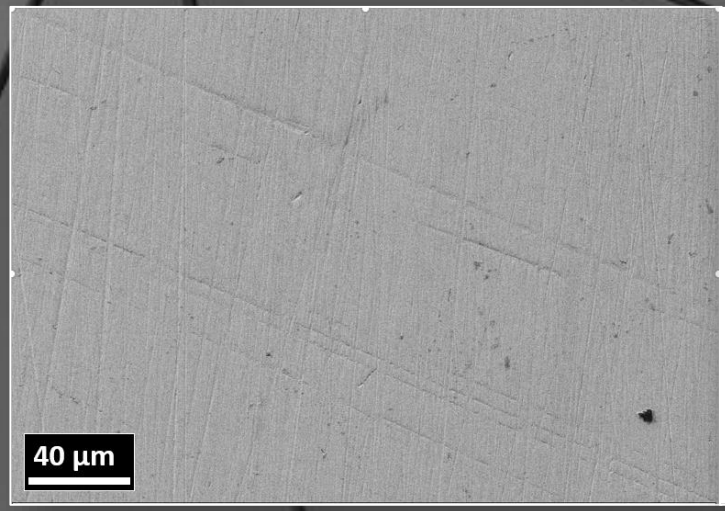
Milled Powder

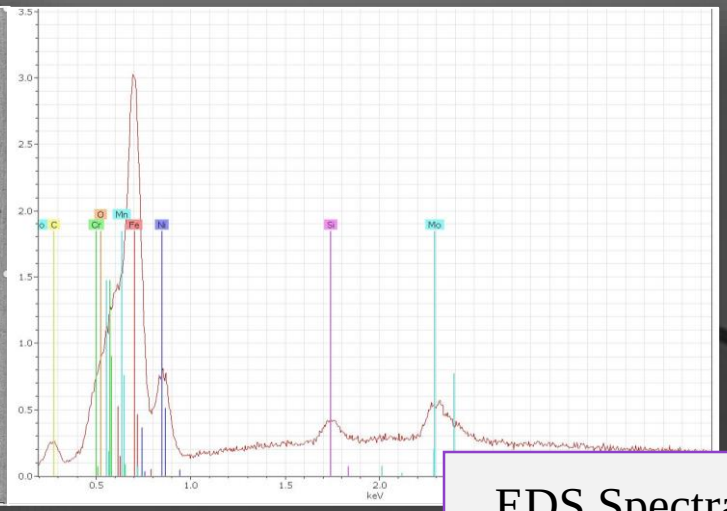


EDS Spectra



XRD

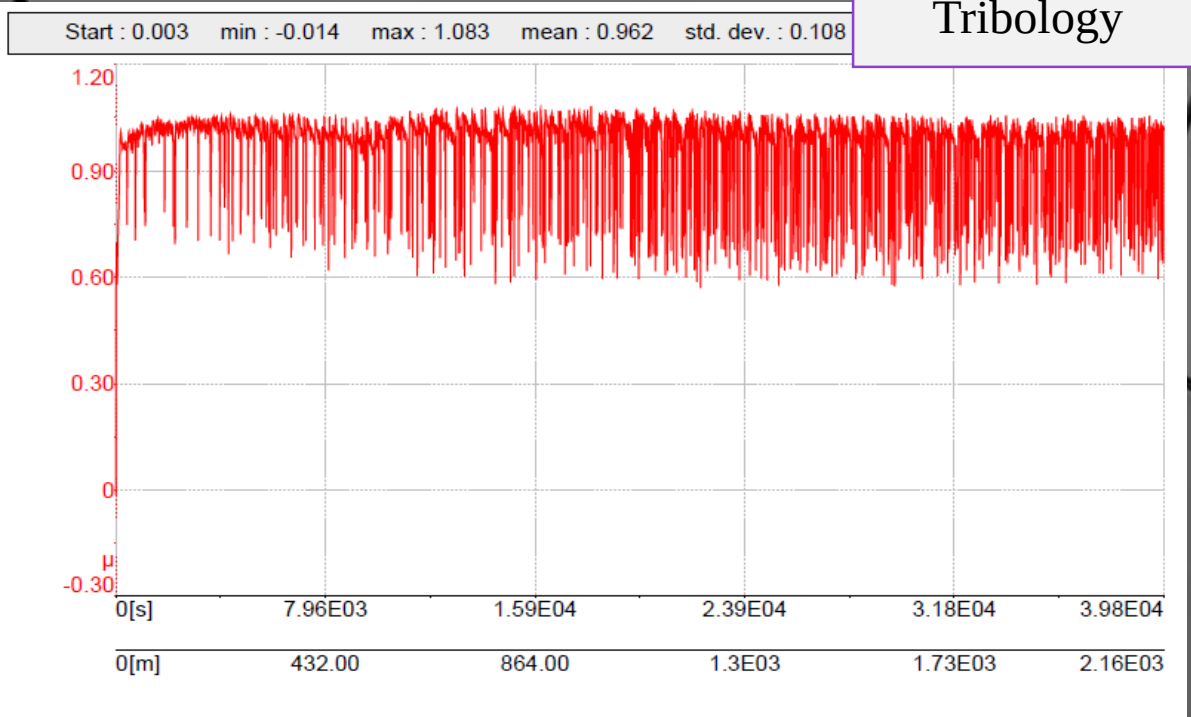


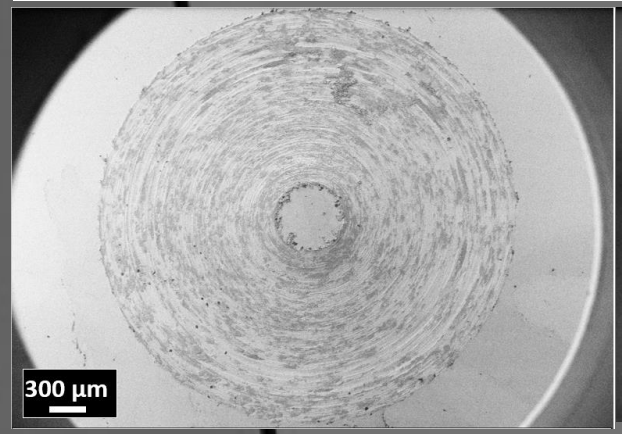


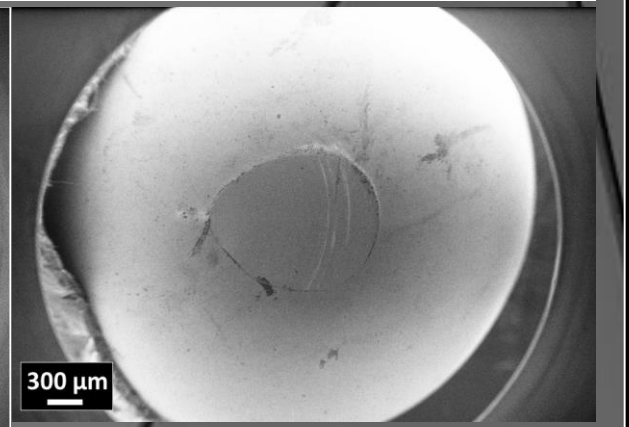
EDS Spectra

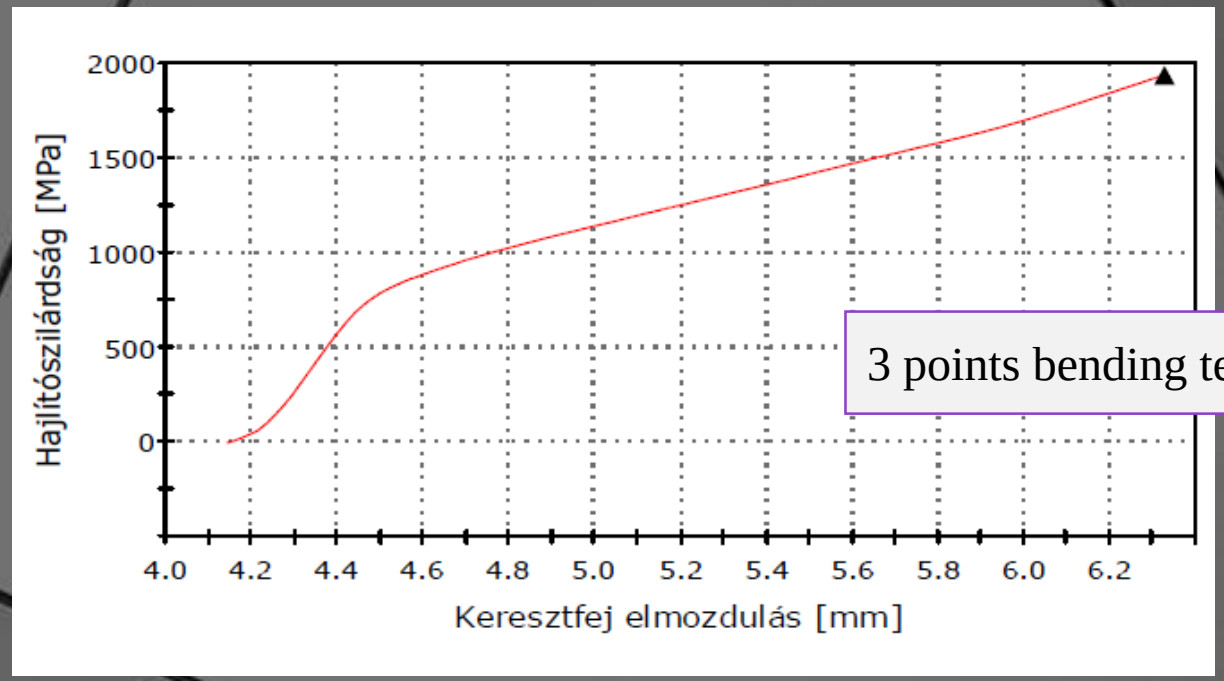
316L reference

Tribology









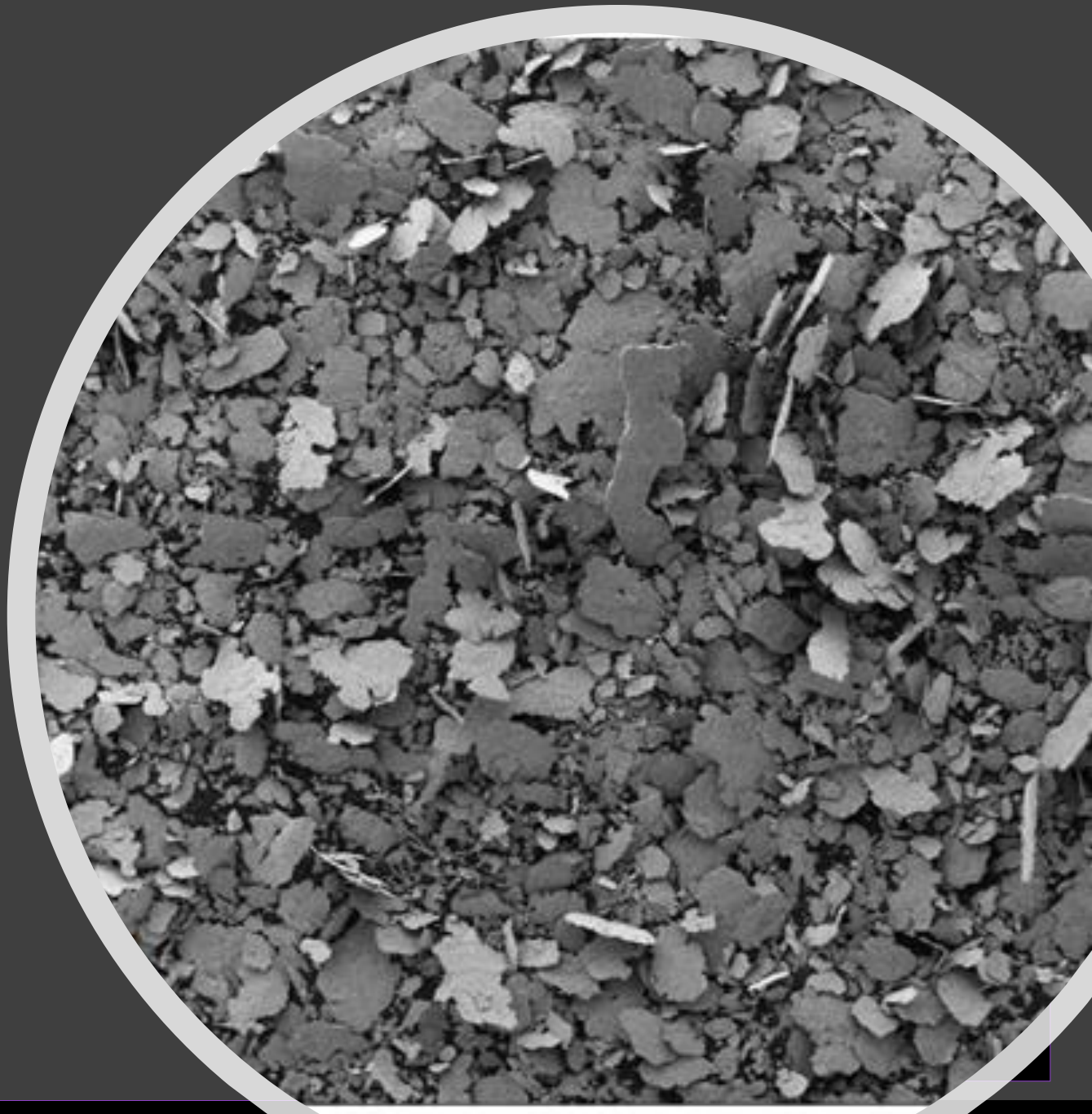
3 points bending test

TEM

Average Density = 7.93

Average HV= 178.6 ± 0.05

316L/ 0.33 wt% Si_3N_4



316L/ 0.33 wt% Si_3N_4

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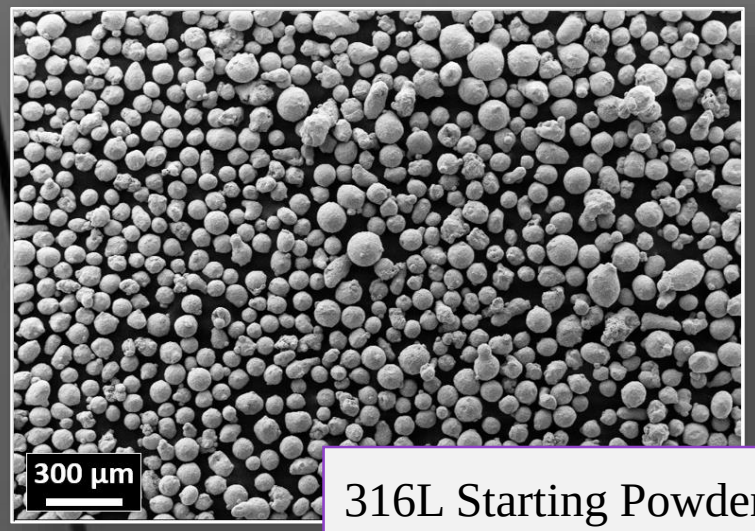
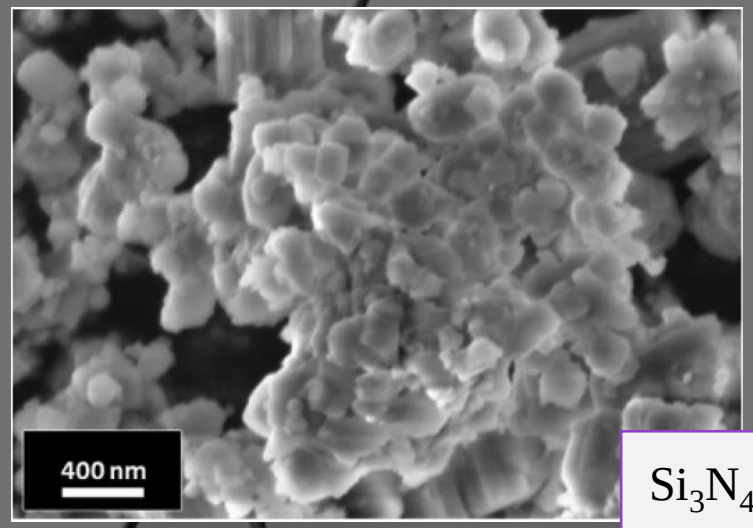
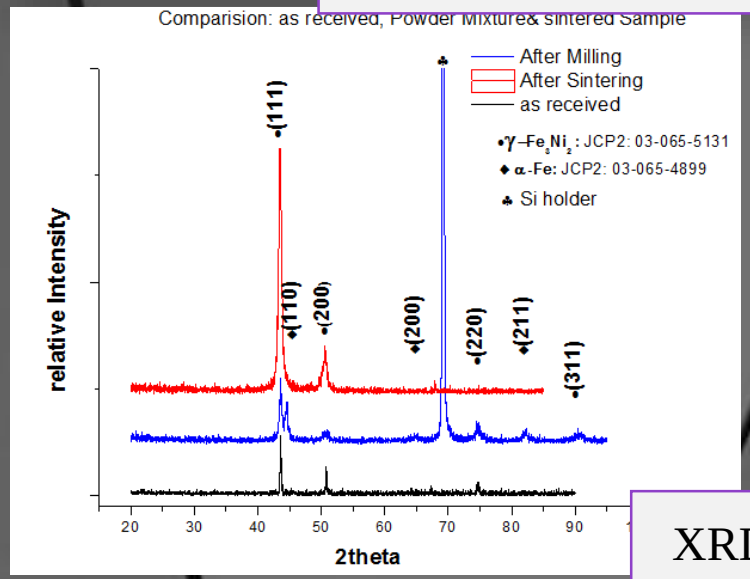


316L Starting Powder

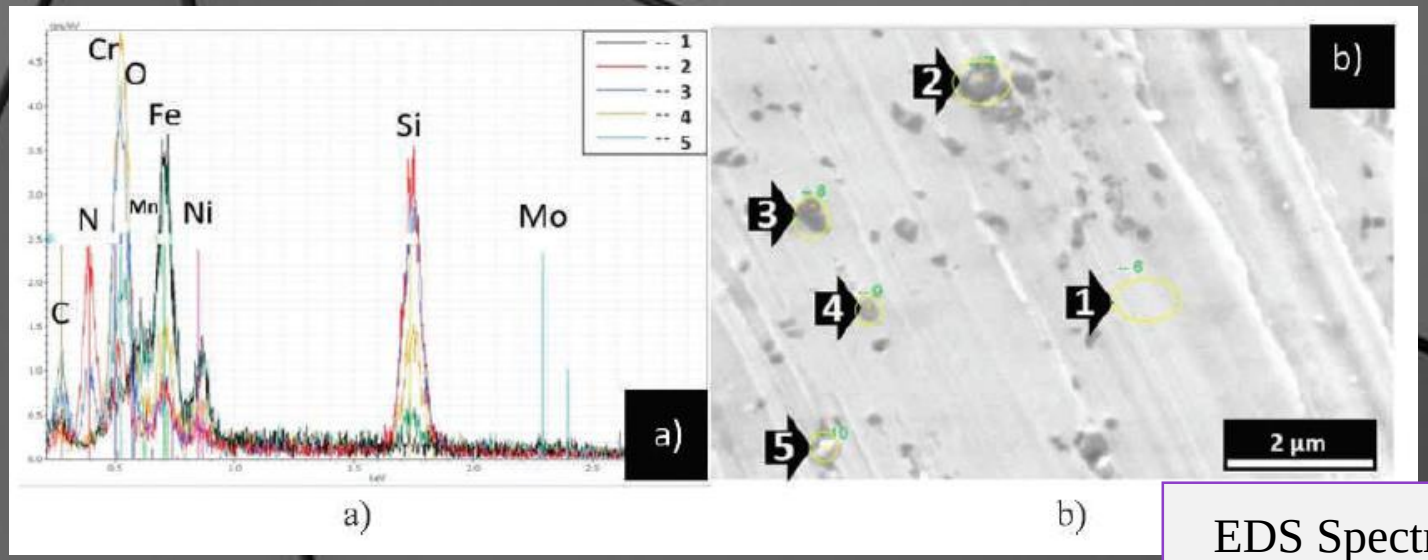


Si_3N_4

Milled Powders



XRD



EDS Spectra

316L/ 0.33 wt% Si_3N_4

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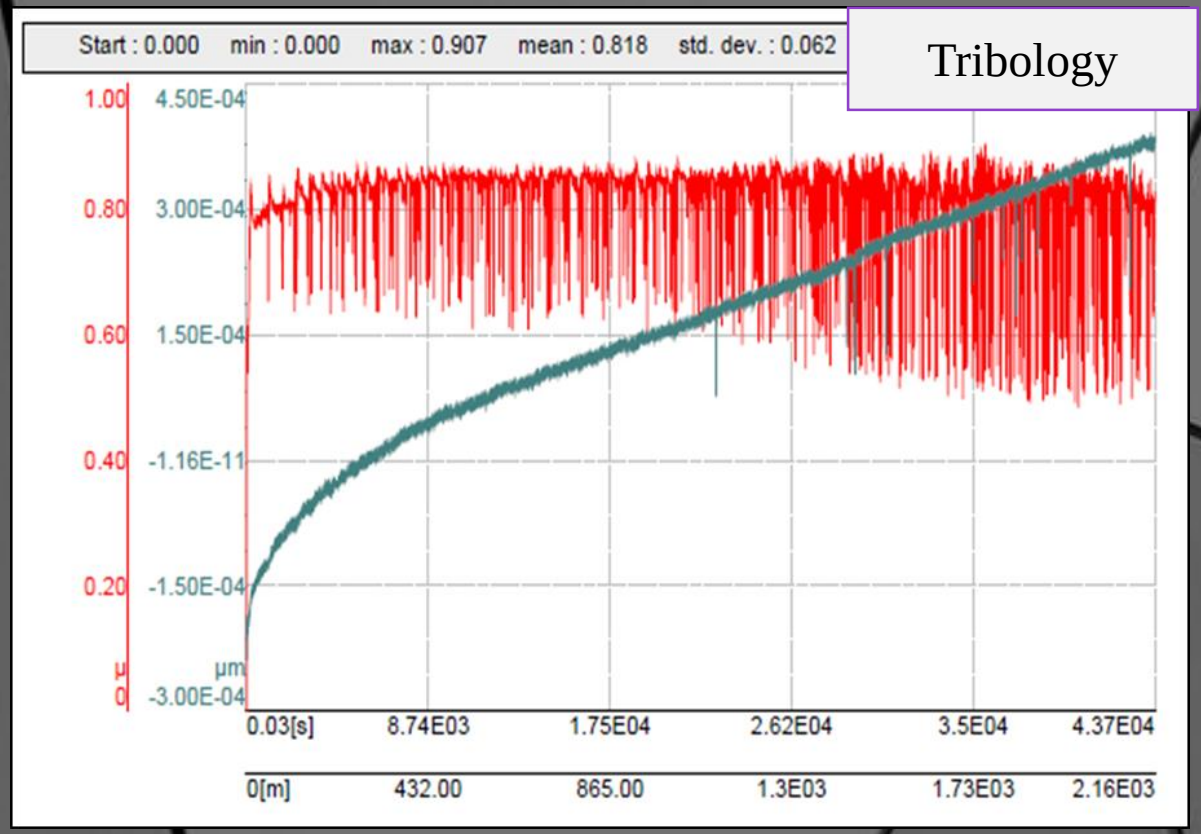
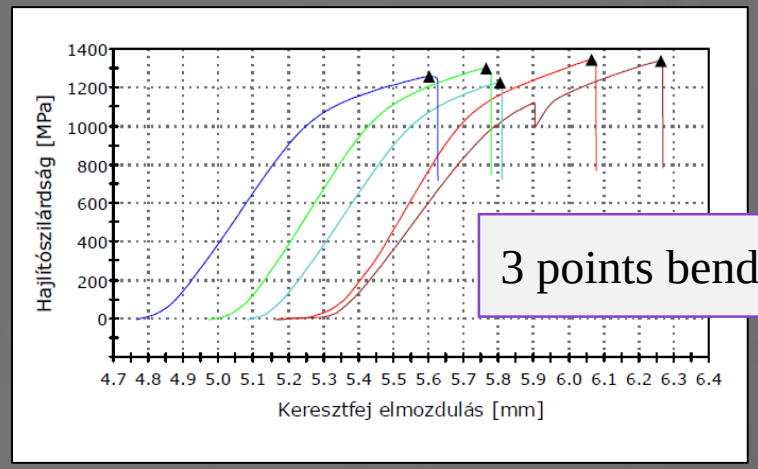
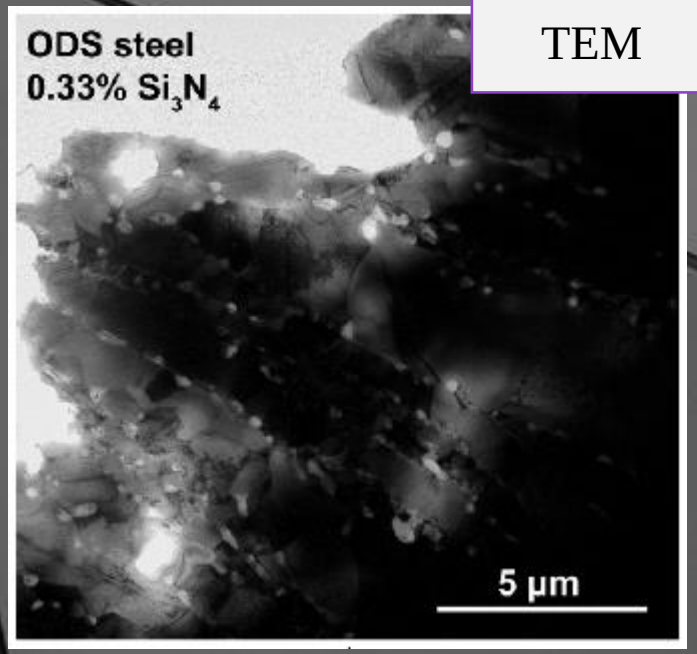


Tribology



3 points bending test

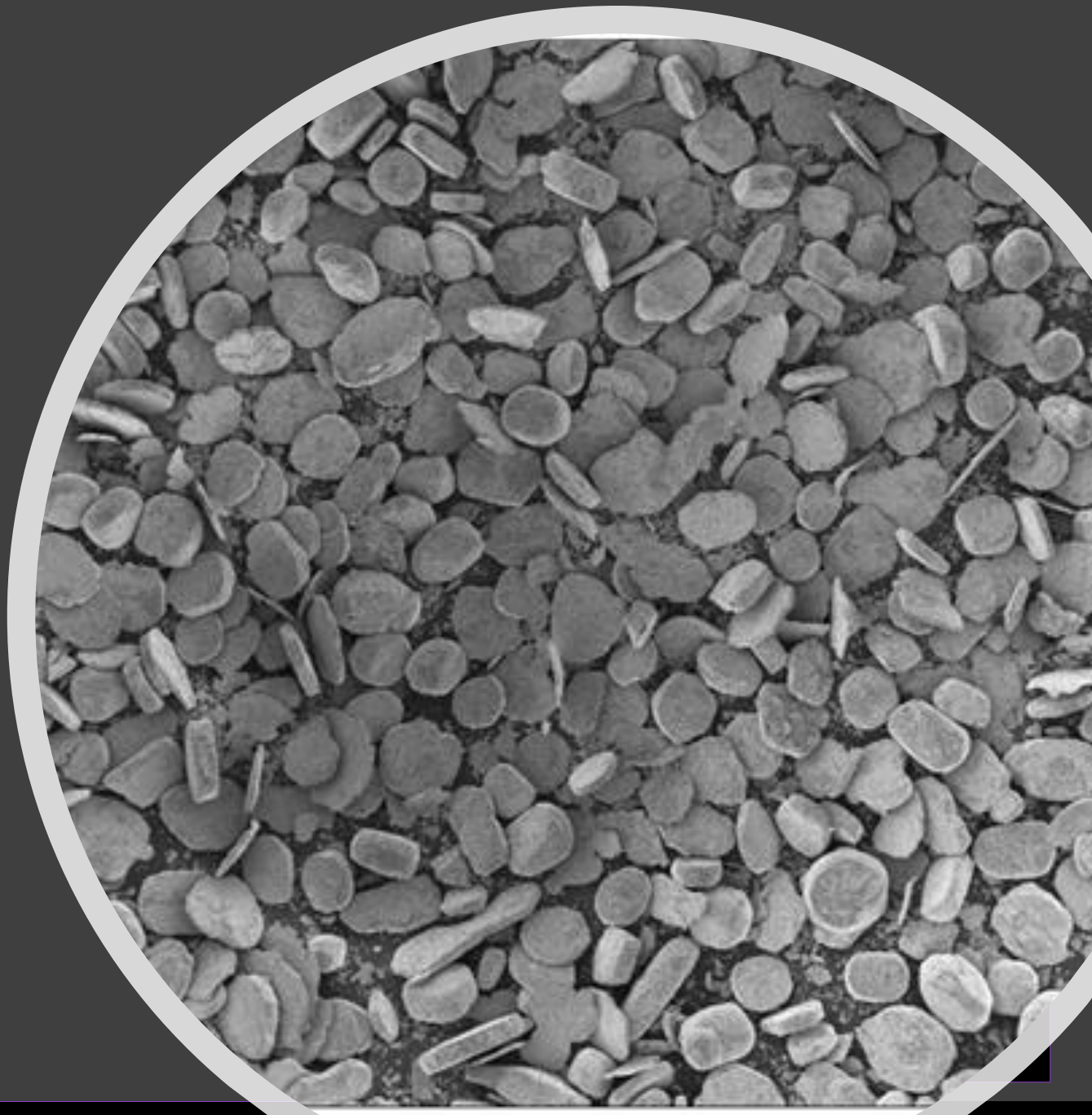


TEM

Average Density = 7.67

Average HV= 340.6 ± 0.17

316L/ 1 wt% Si_3N_4



316L/ 1 wt% Si_3N_4

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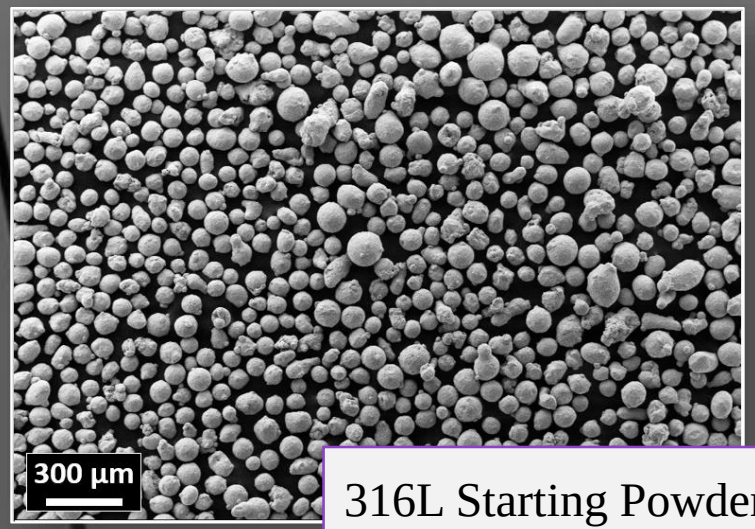
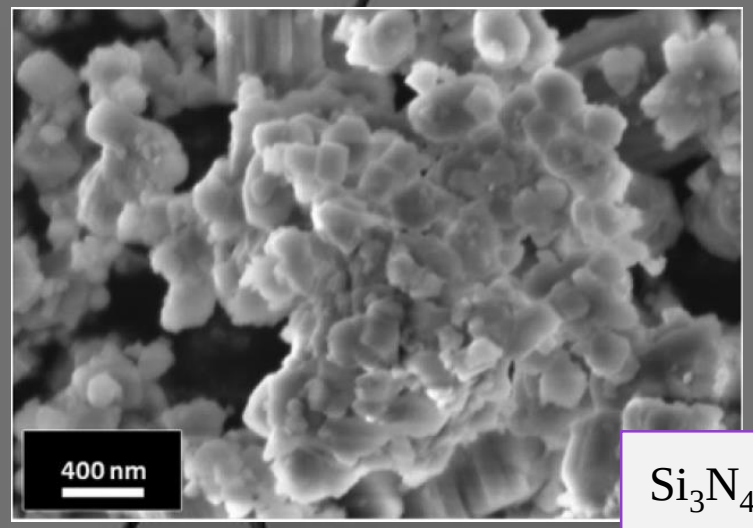
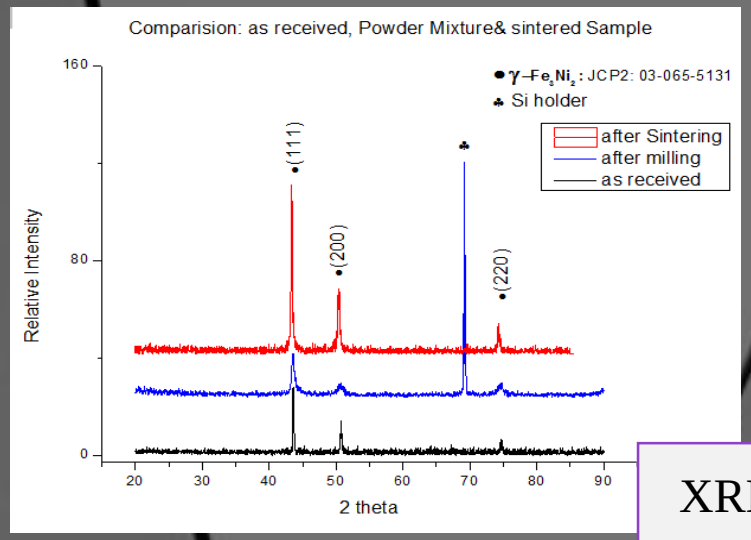


316L Starting Powder

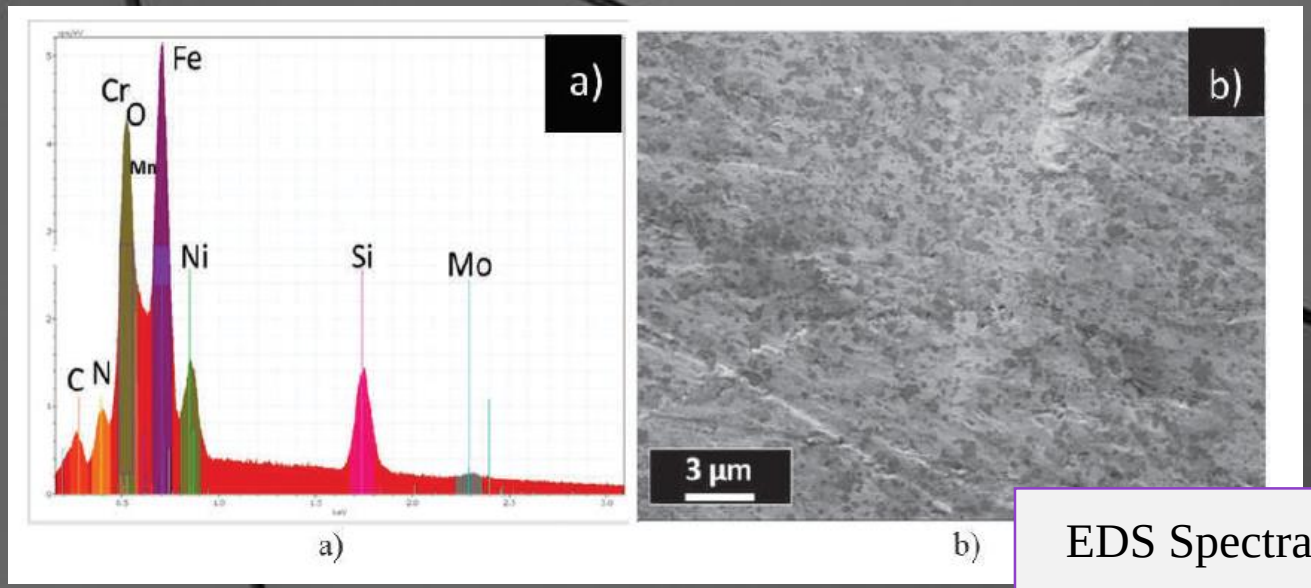


Si_3N_4

Milled Powders



XRD



EDS Spectra

316L/ 1 wt% Si_3N_4

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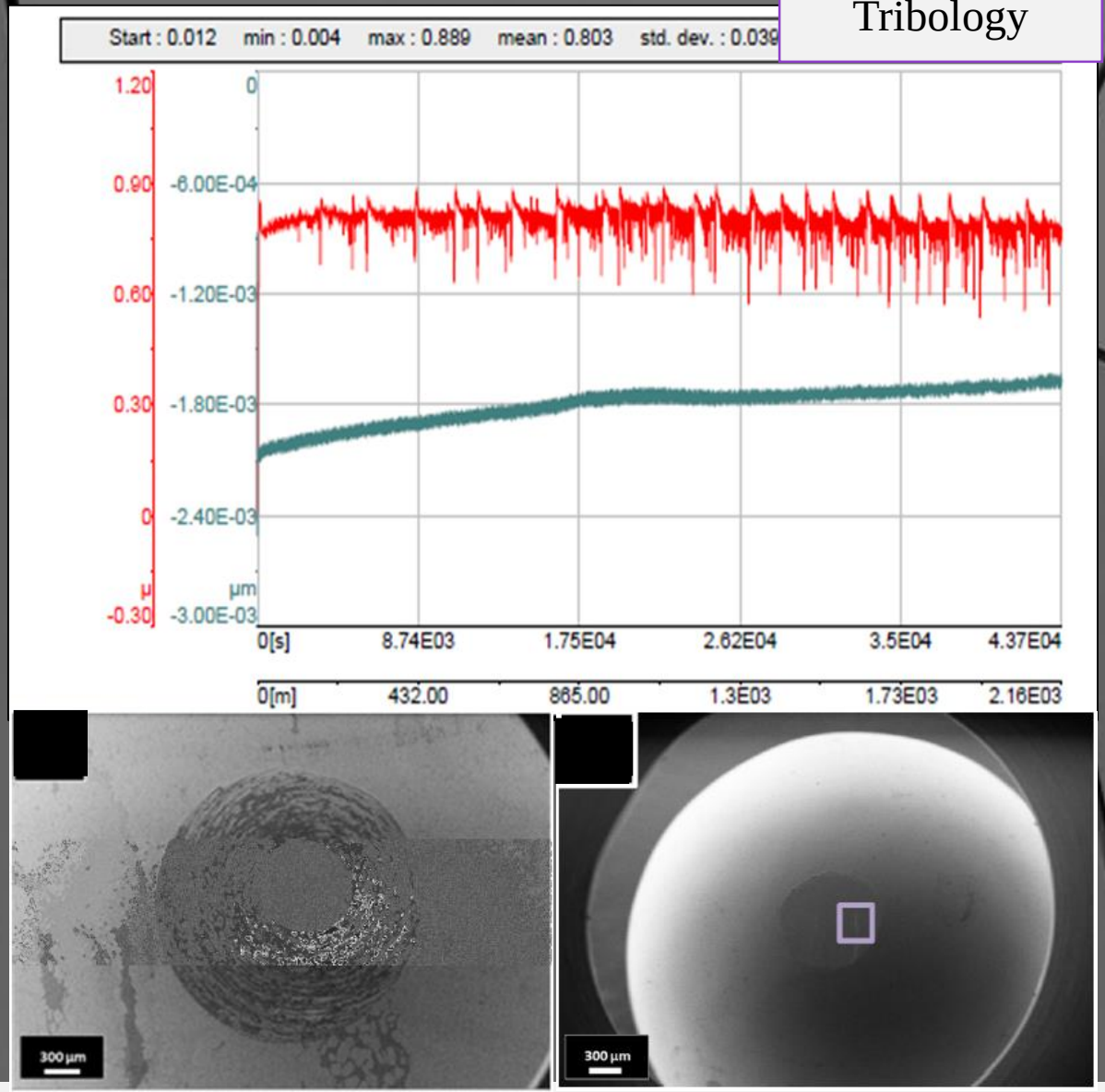
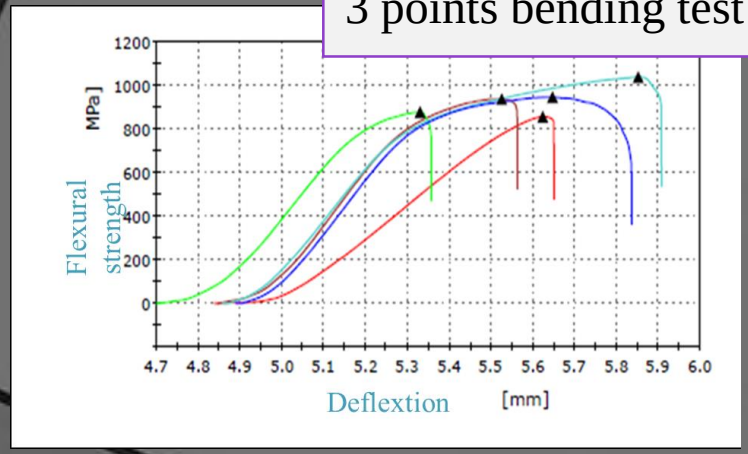
Tribology

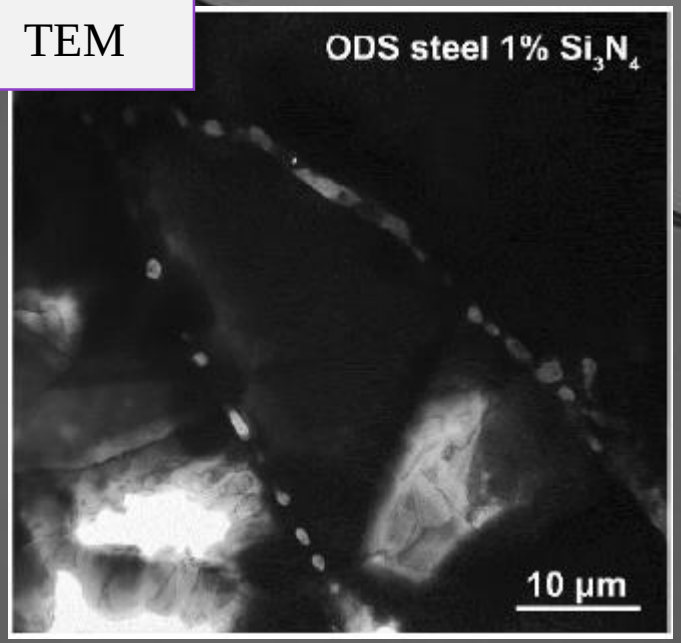


3 points bending test



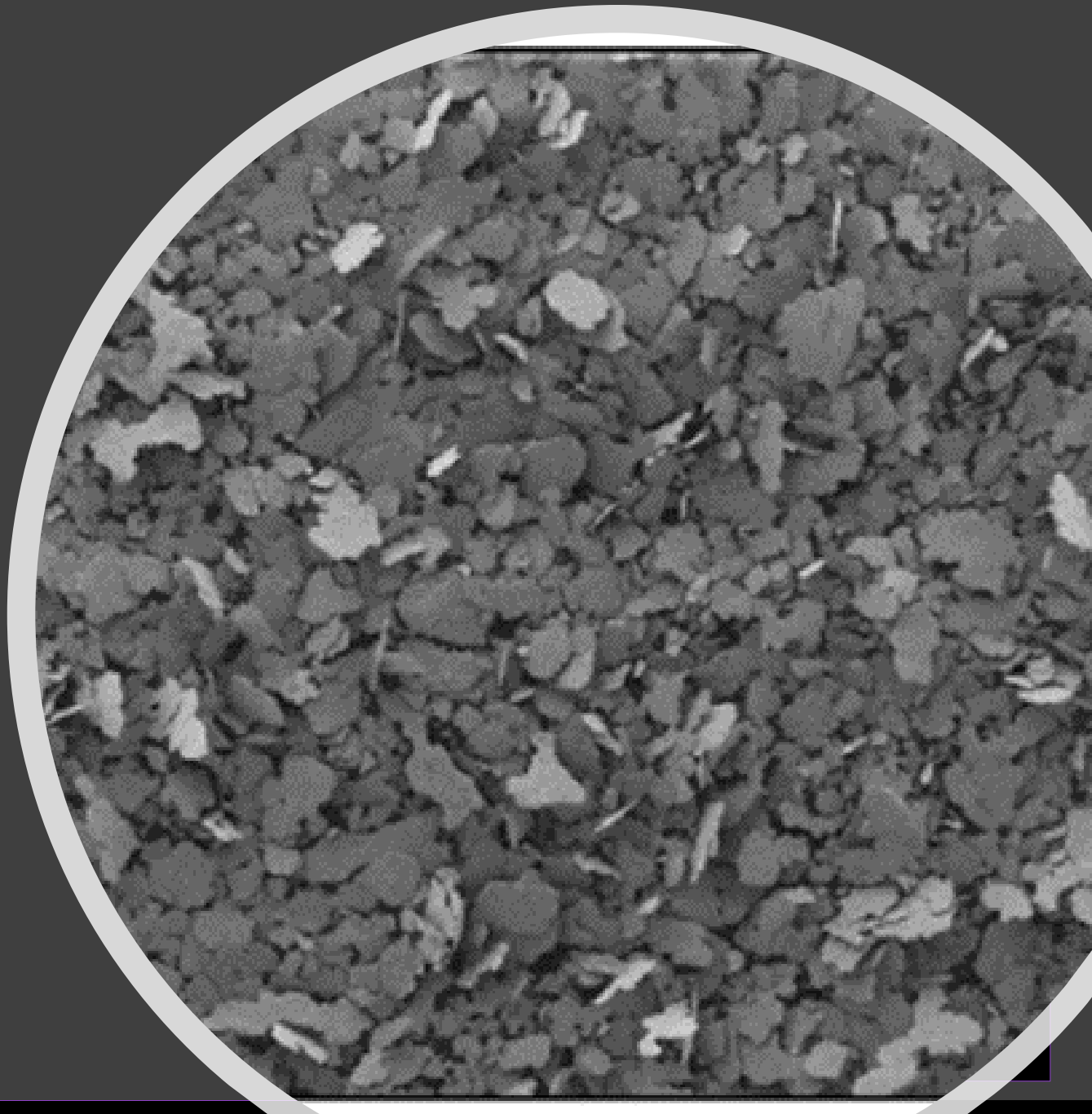
Average Density = 7.64

TEM



Average HV= 274.6 ± 0.28

316L/ 0.33 wt% SiC



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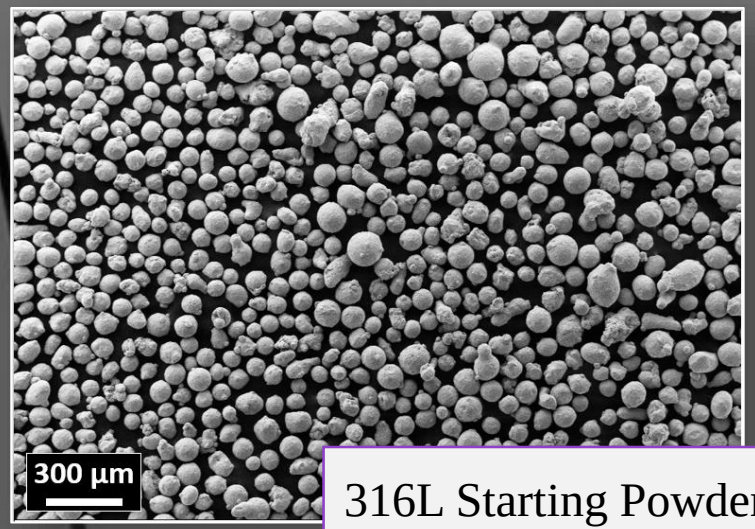
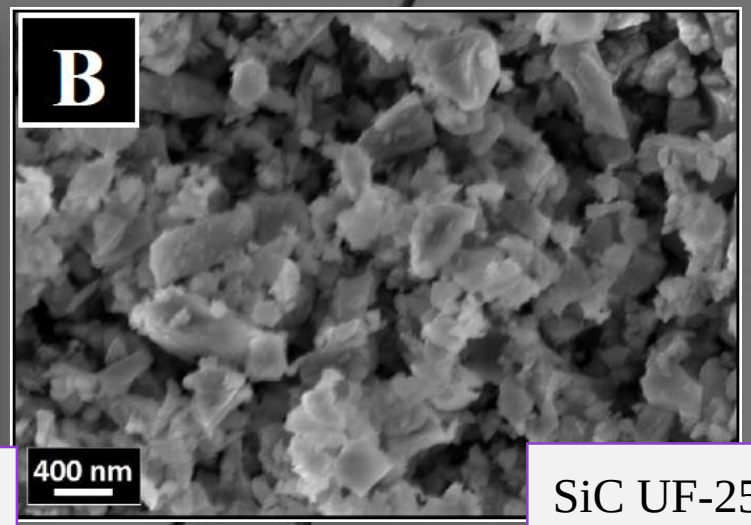
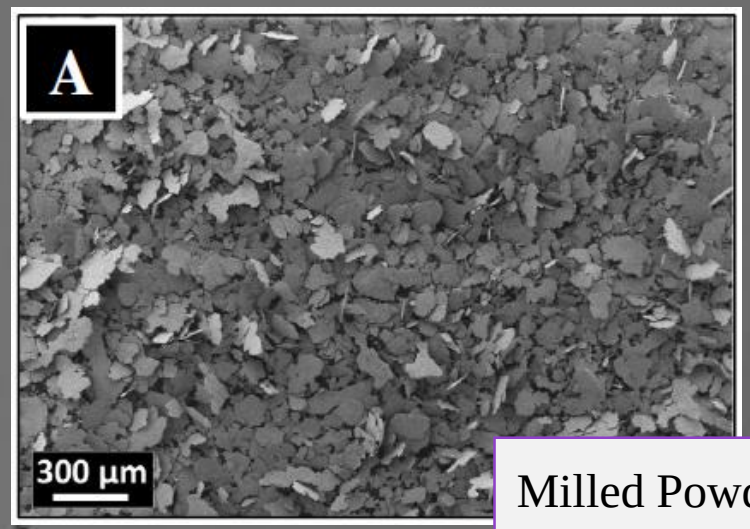
316L/ 0.33 wt% SiC



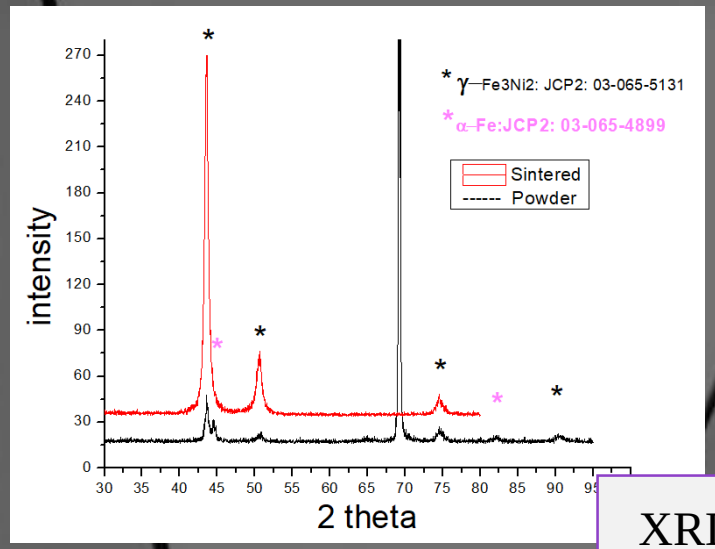
316L Starting Powder



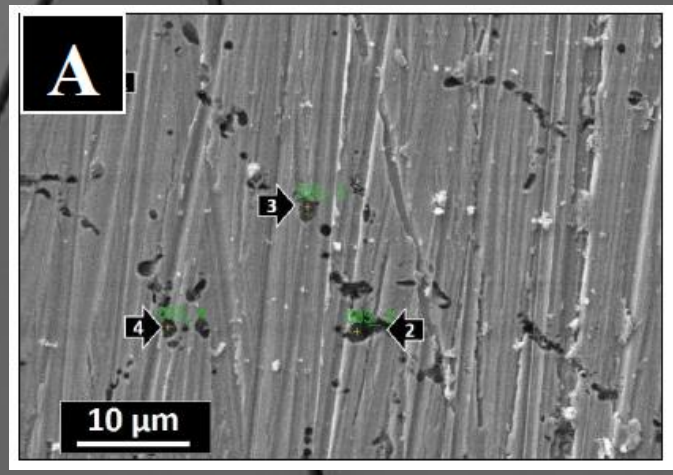
SiC UF-25

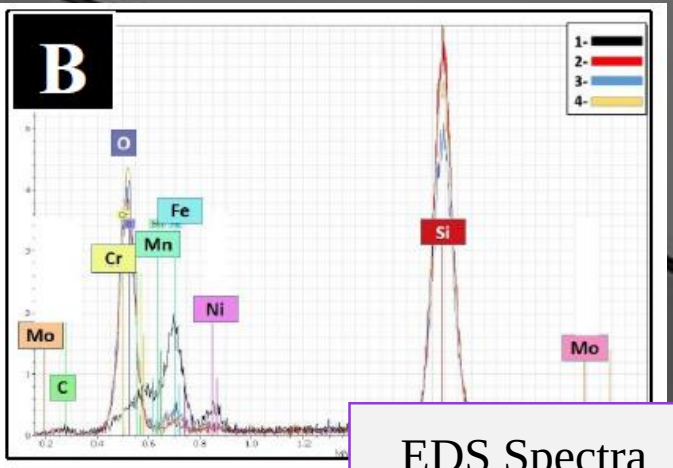


Milled Powders



XRD

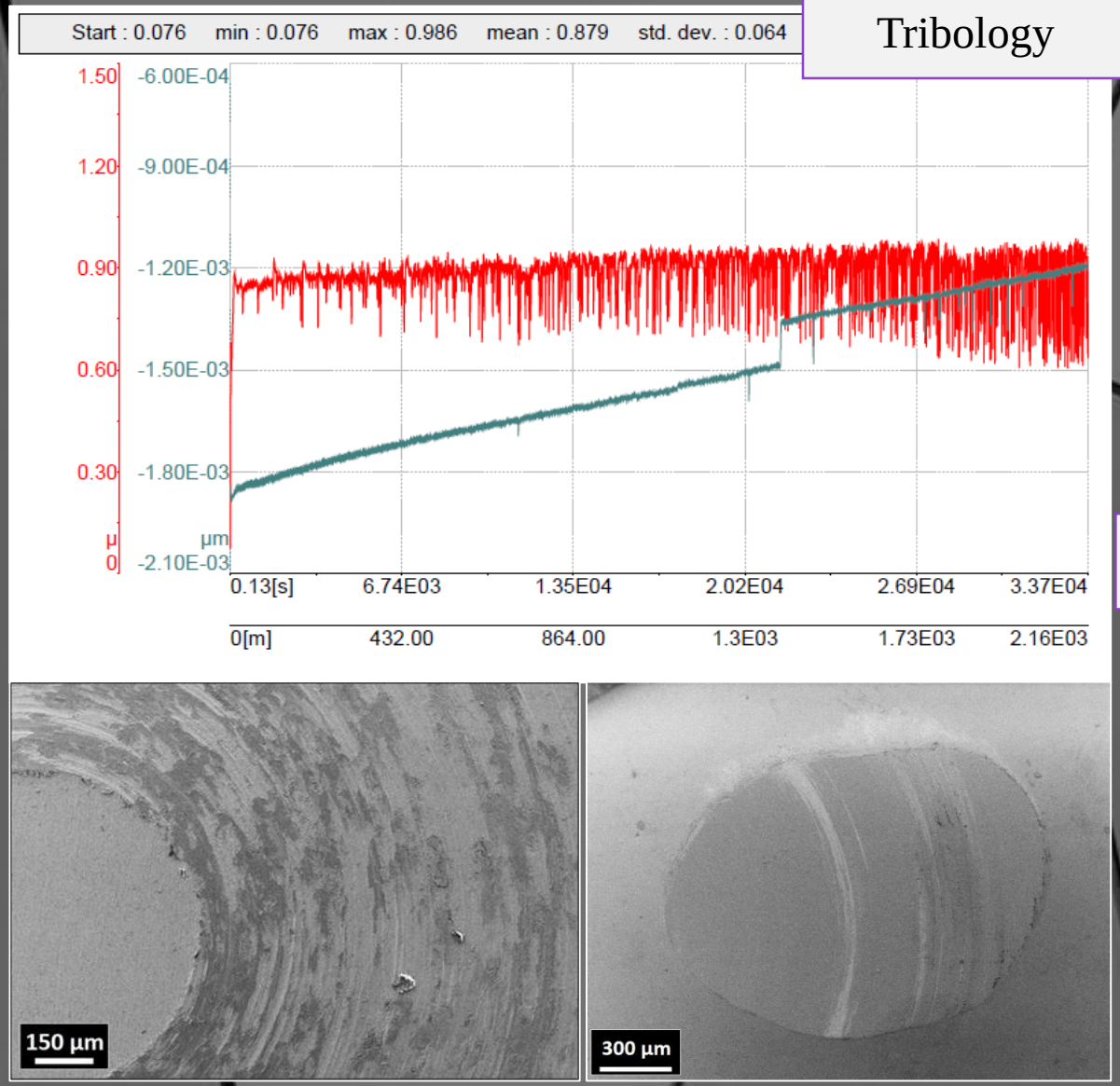


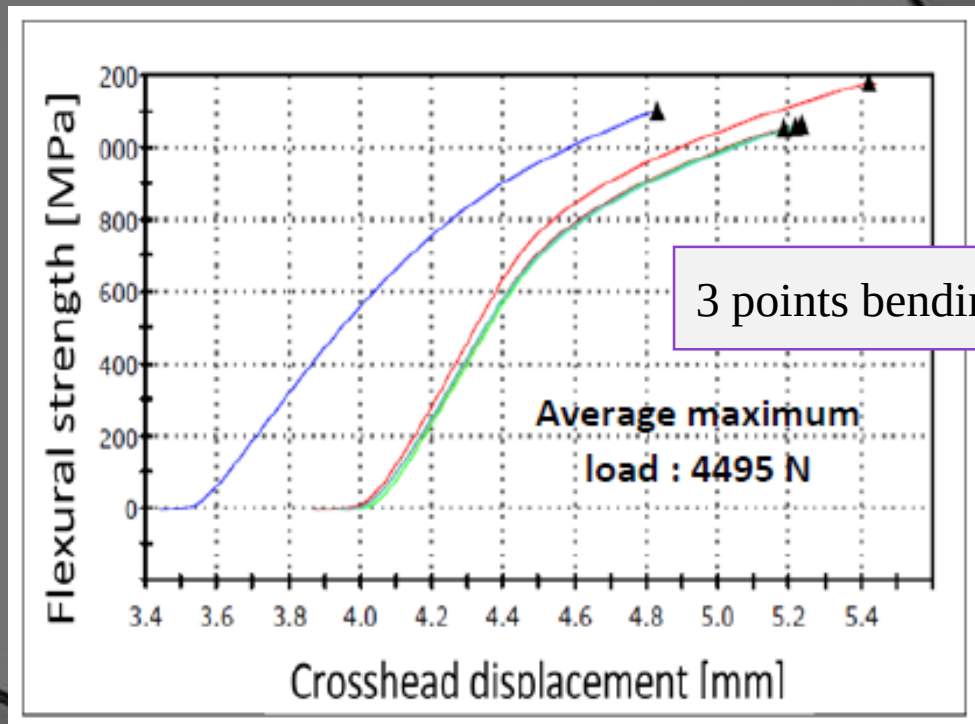


EDS Spectra

316L/ 0.33 wt% SiC

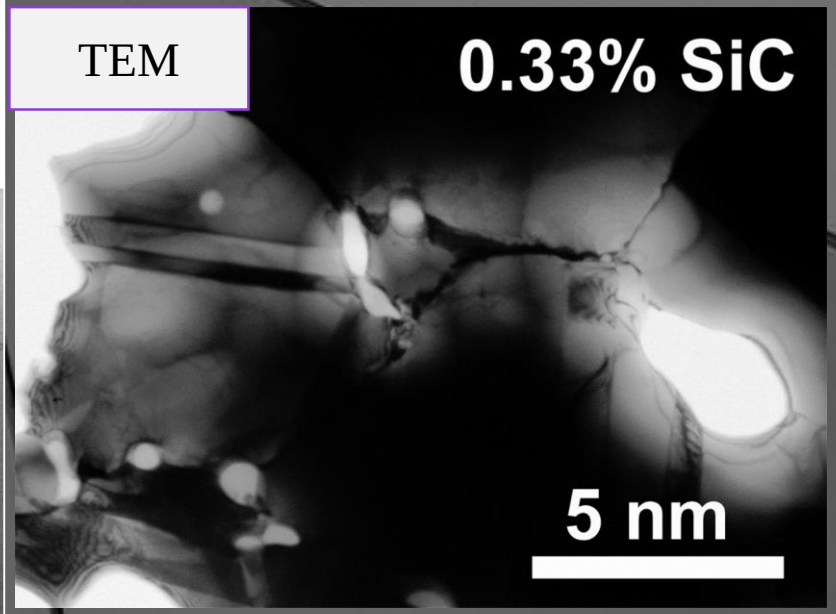
Tribology





3 points bending test

TEM

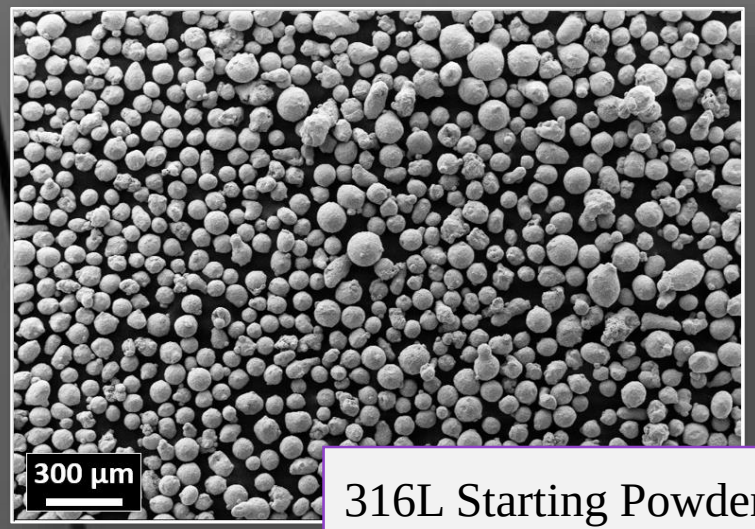


Average Density = 7.73

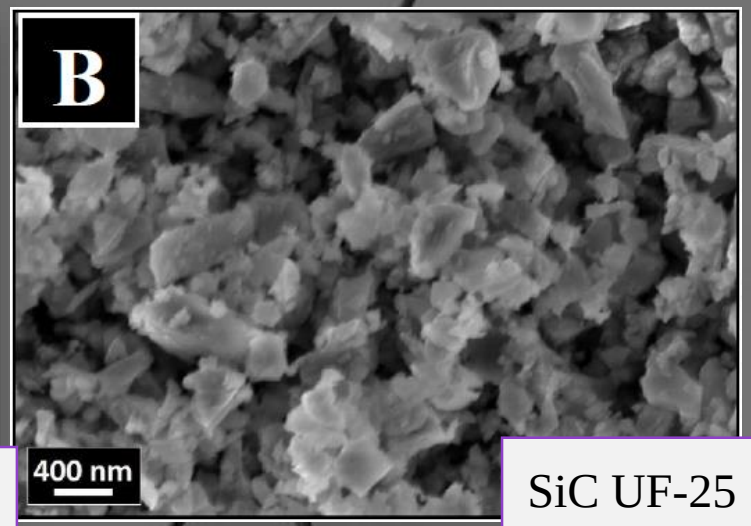
Average HV= 303.9 ± 0.27

316L/ 1 wt% SiC

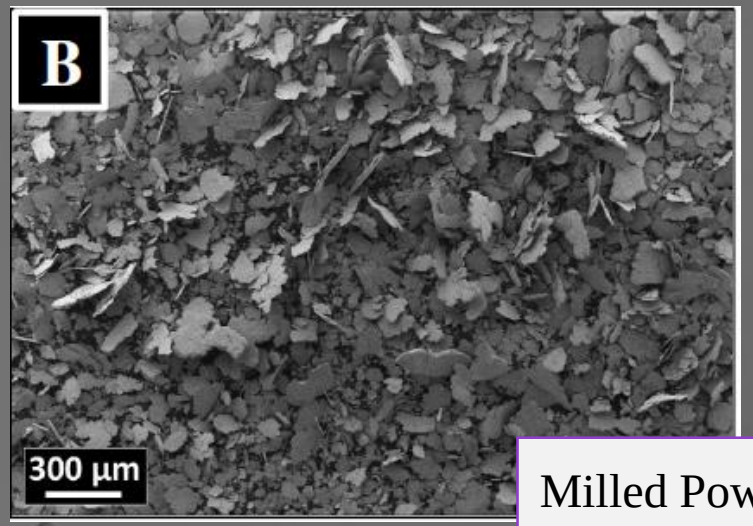
316L/ 1 wt% SiC



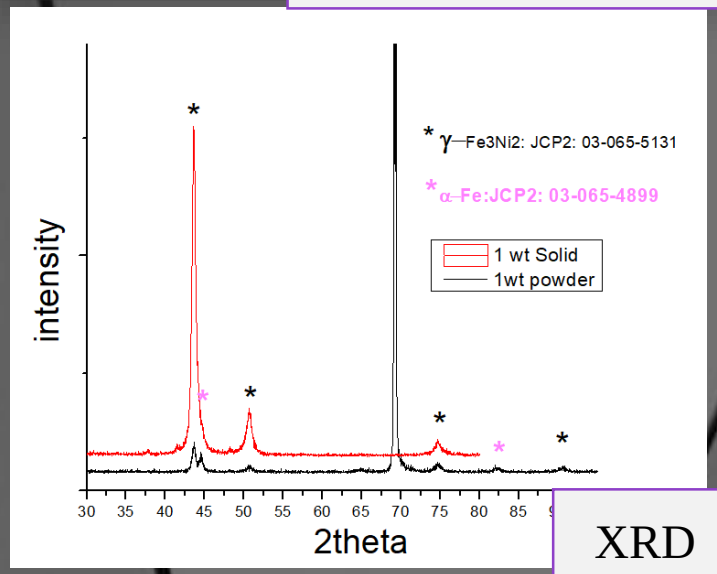
316L Starting Powder



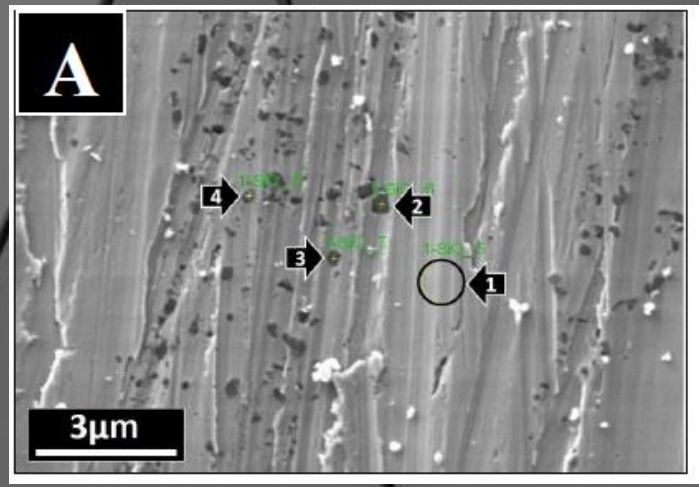
SiC UF-25

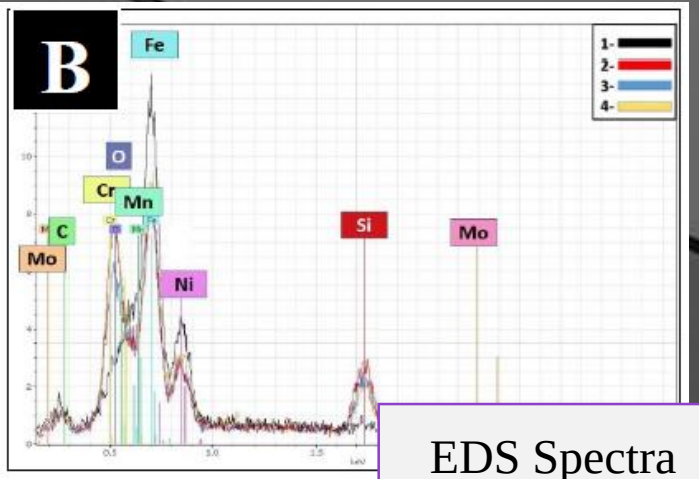


Milled Powders



XRD

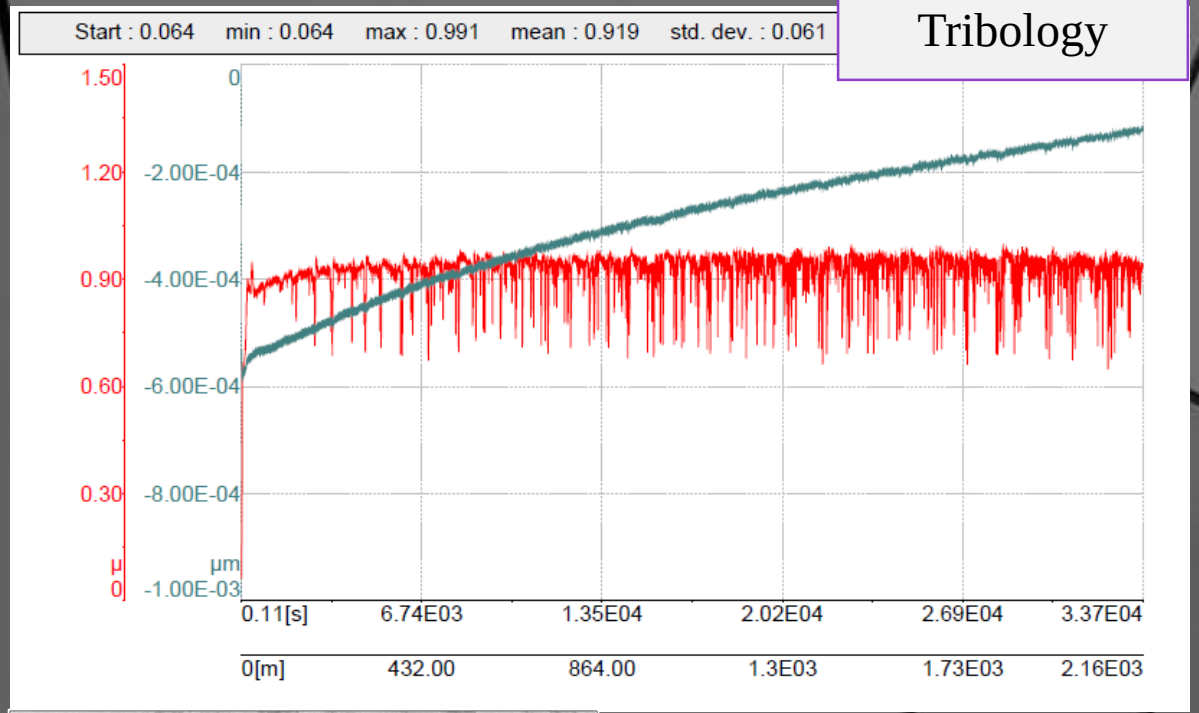


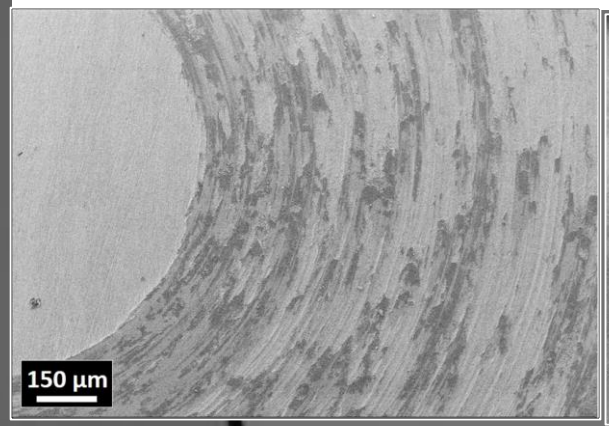


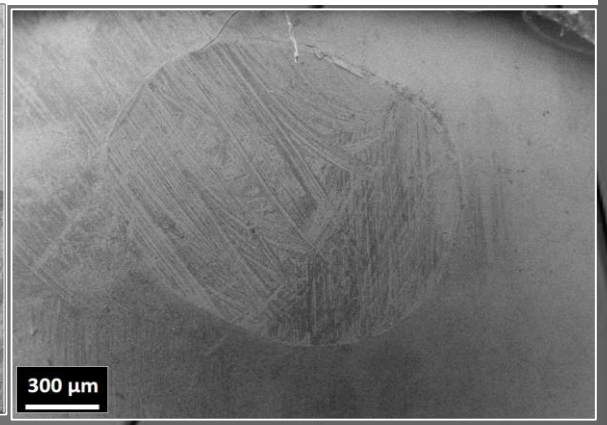
EDS Spectra

316L/ 1 wt% SiC

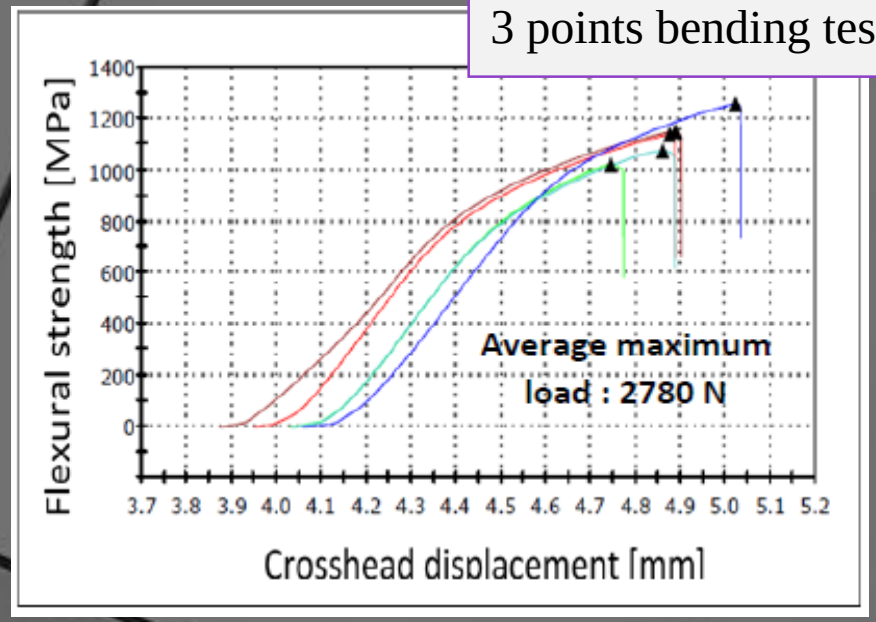
Tribology



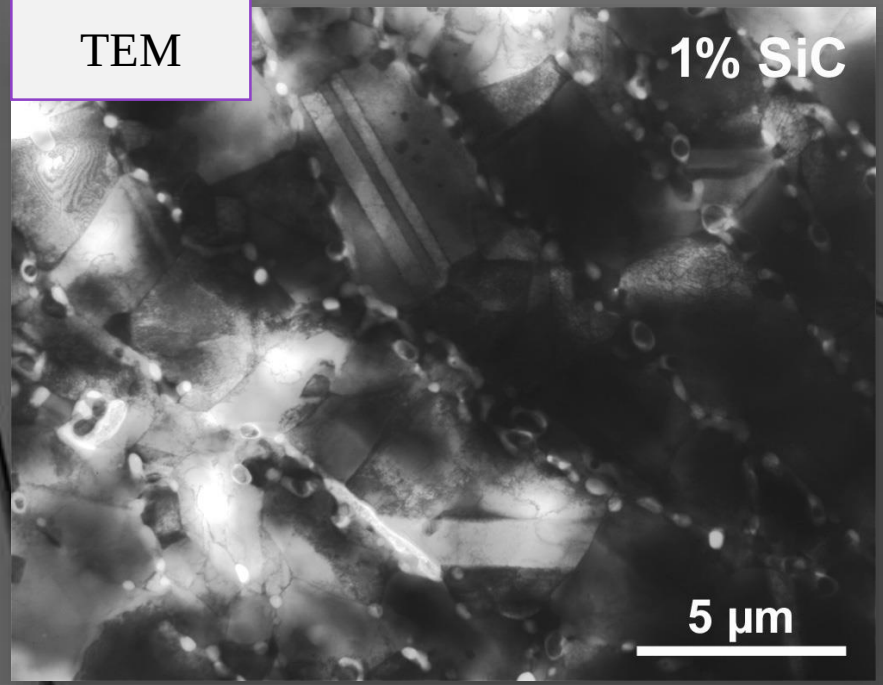




3 points bending test



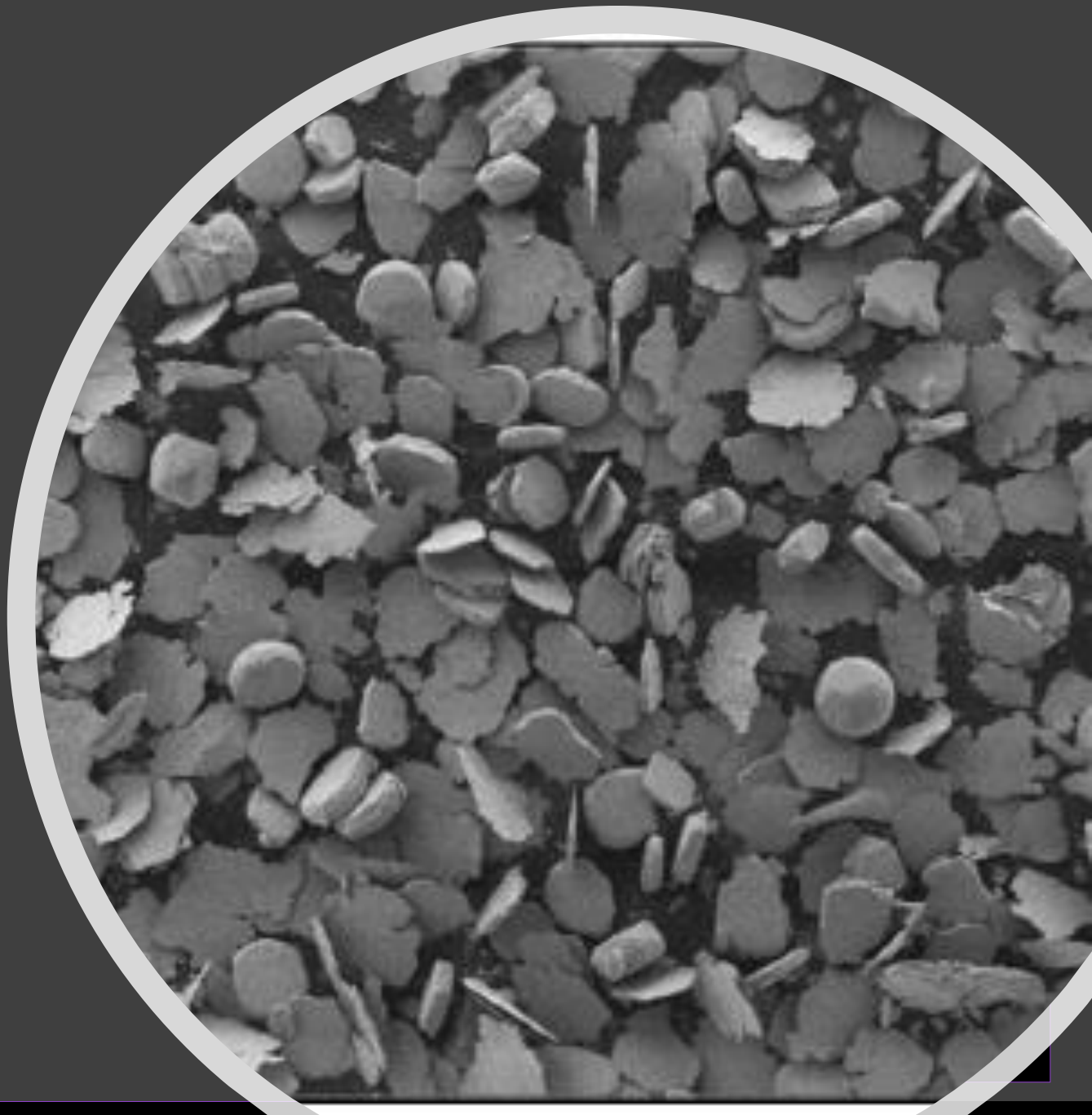
TEM



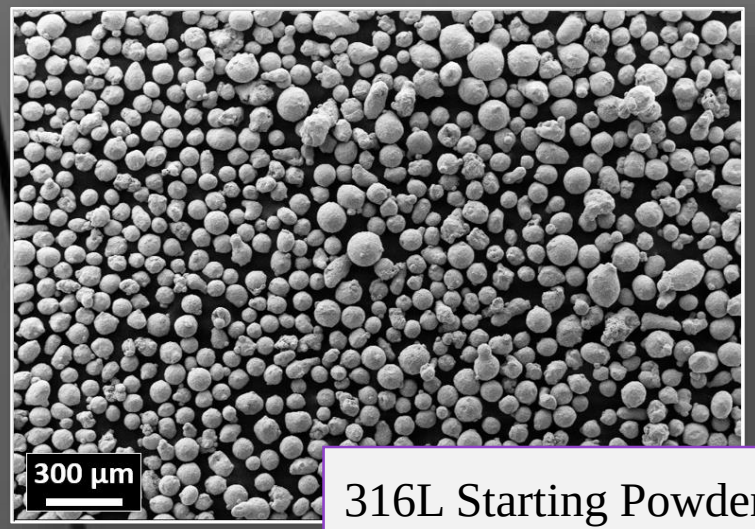
Average Density =7.61

Average HV= 283.5 ± 0.32

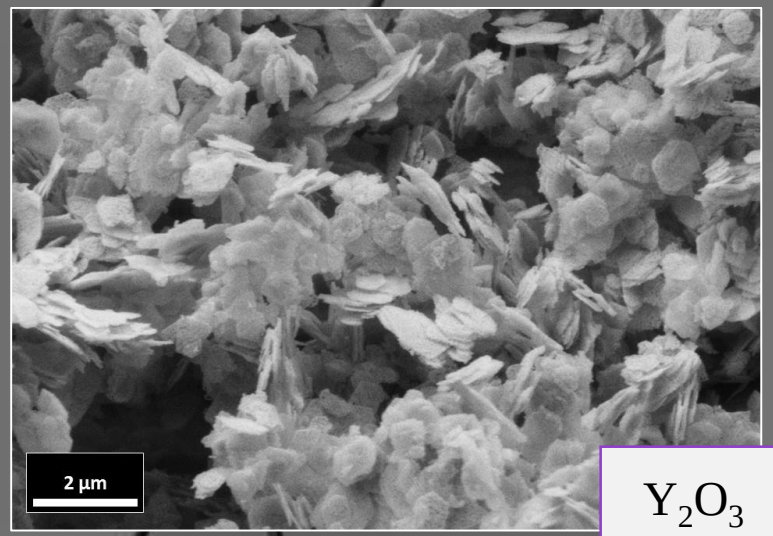
316L/ 0.33 wt% Y_2O_3



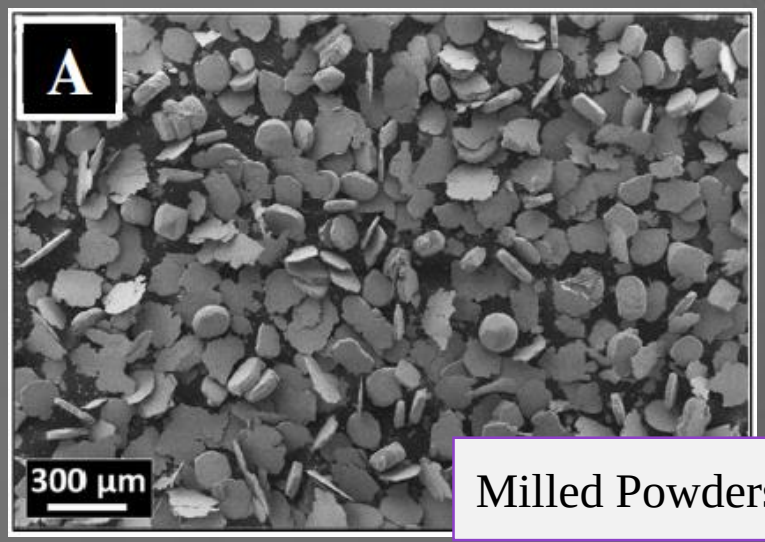
316L/ 0.33 wt% Y_2O_3



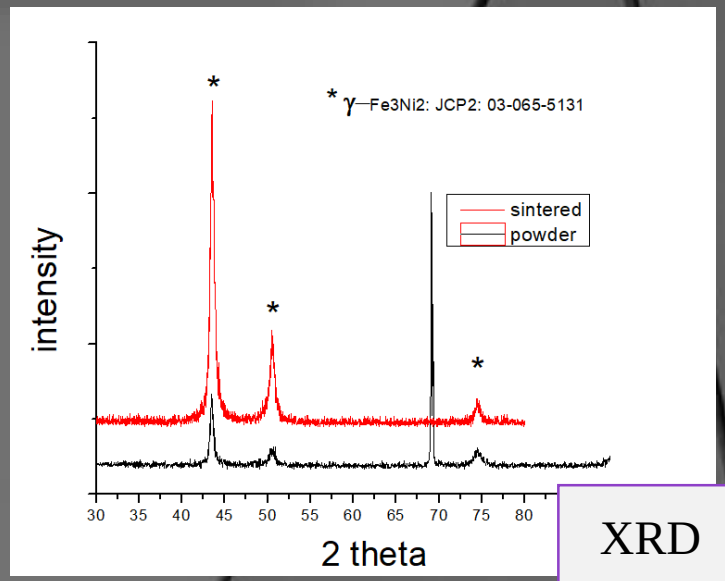
316L Starting Powder



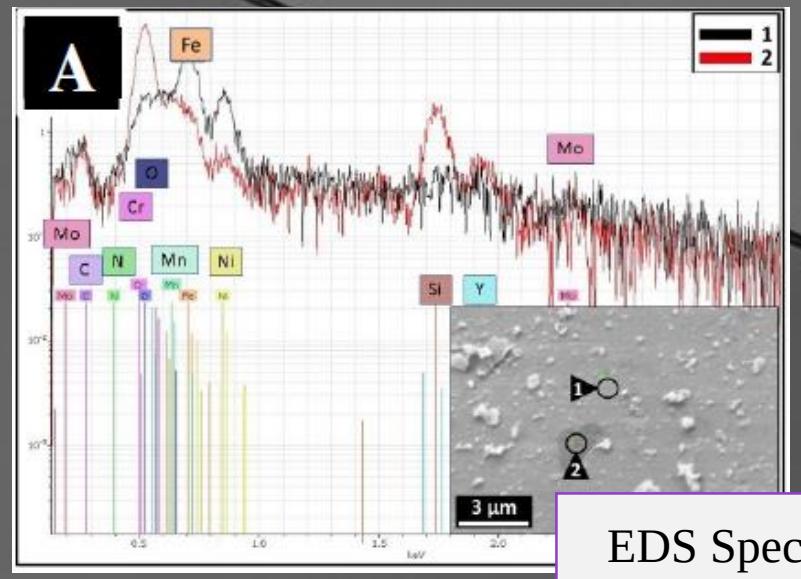
Y_2O_3



Milled Powders



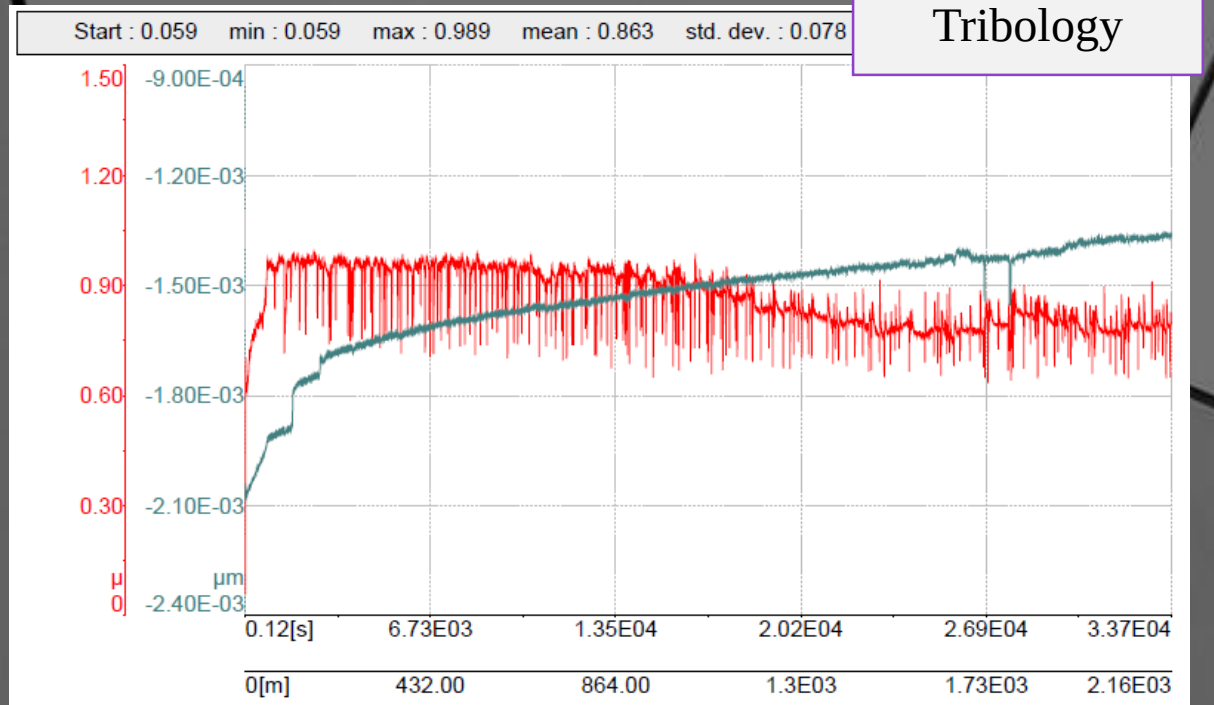
XRD

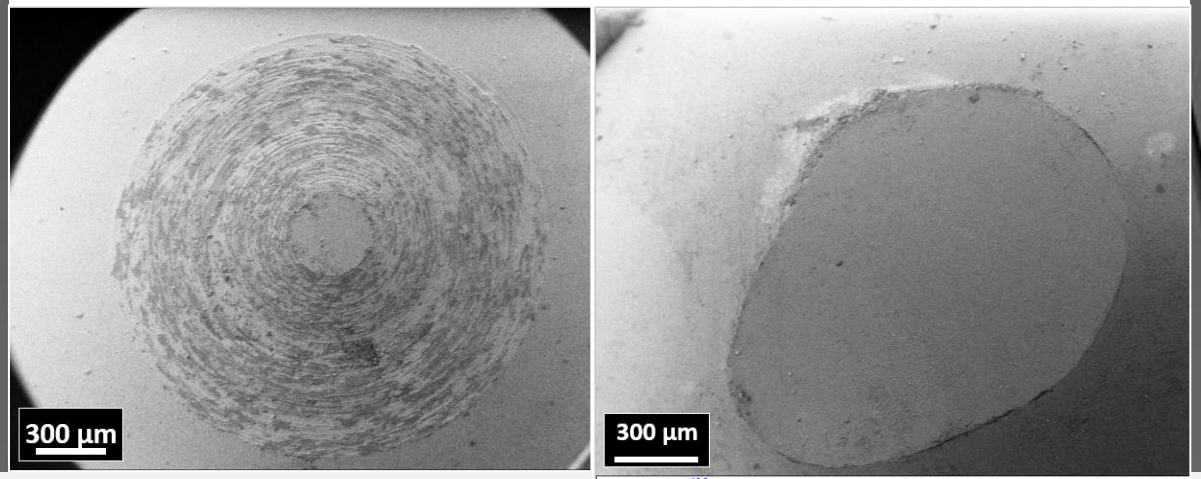


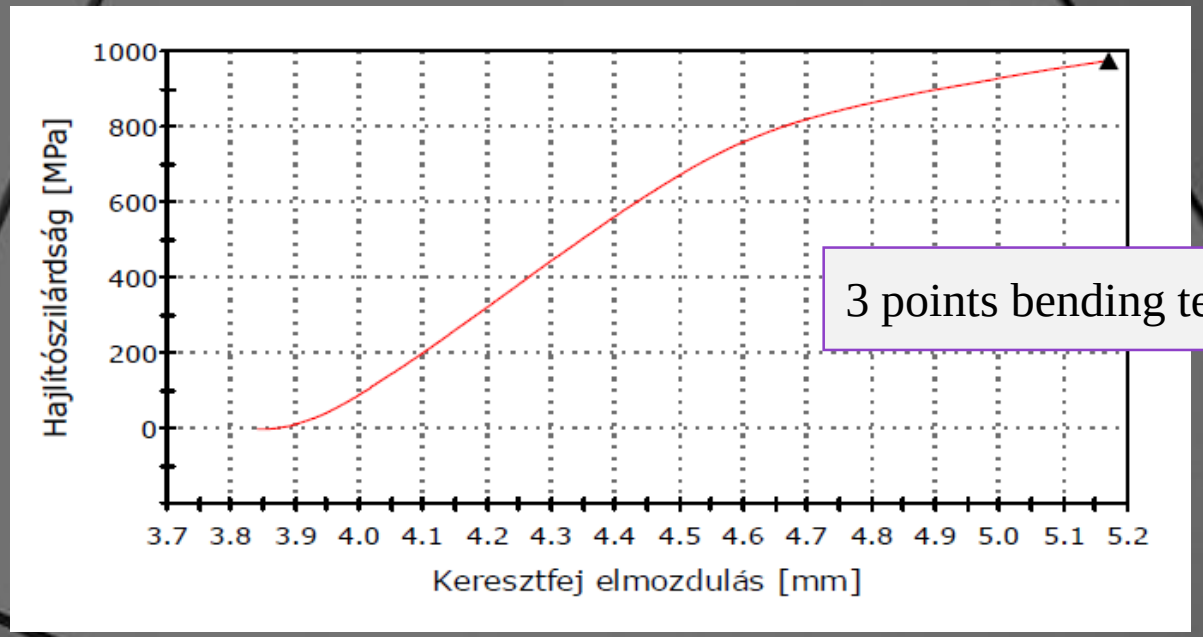
EDS Spectra

316L/ 0.33 wt% Y_2O_3

Tribology

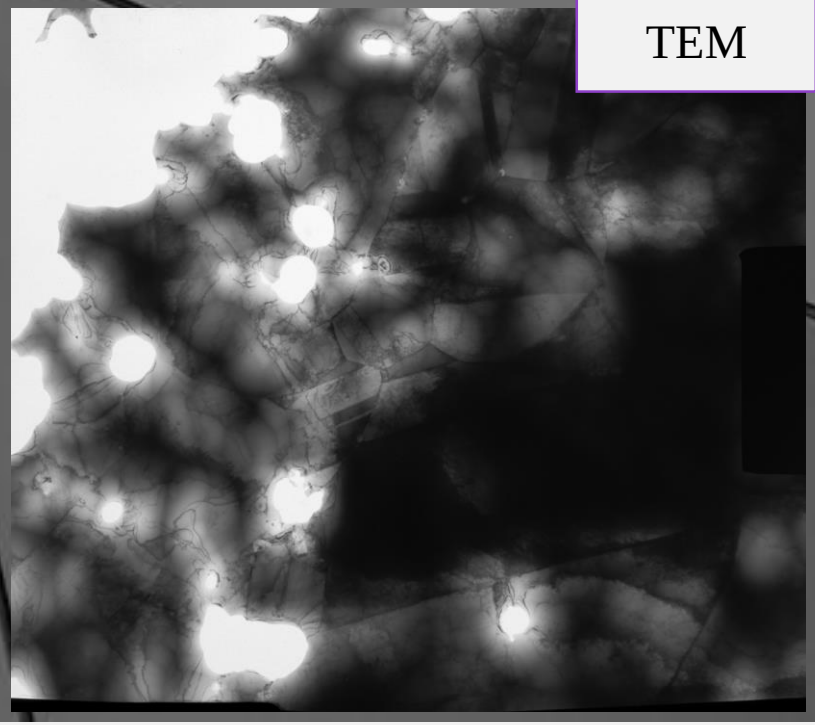






3 points bending test

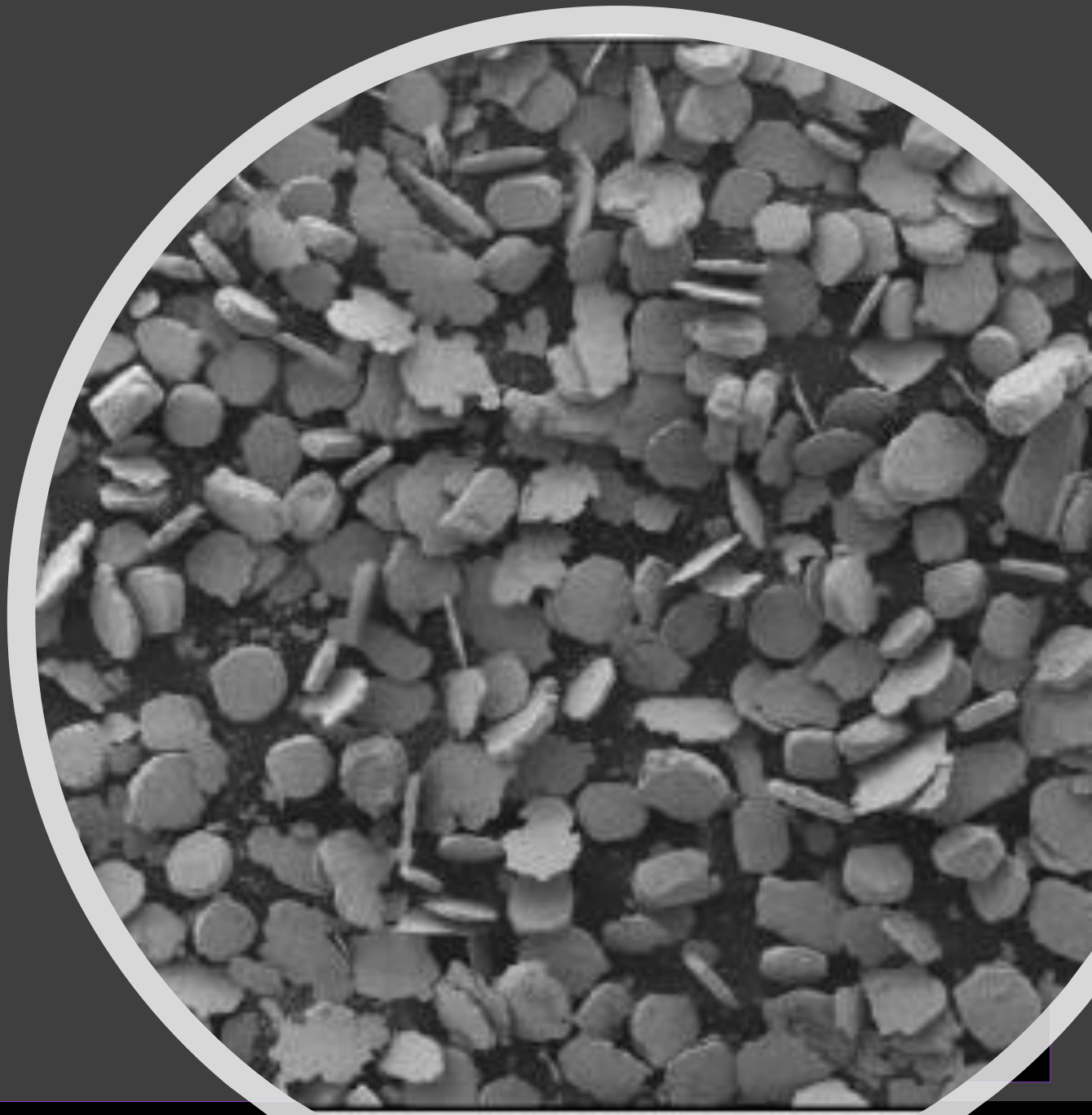
TEM



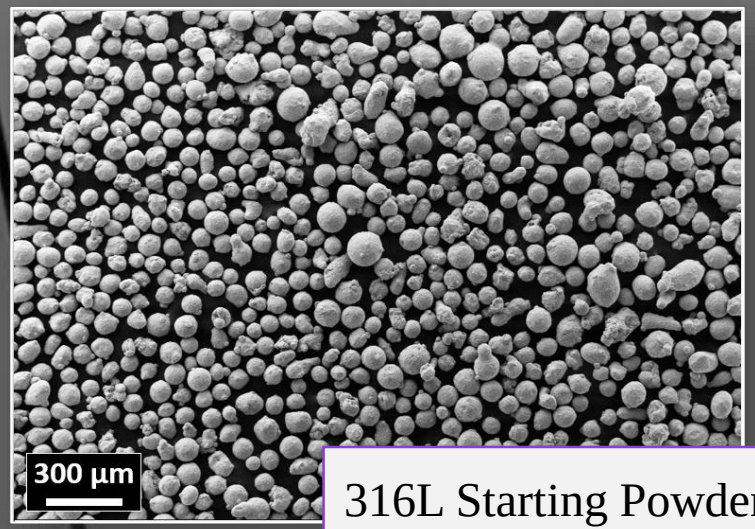
Average Density = 7.891

Average HV= 268.3 ± 0.31

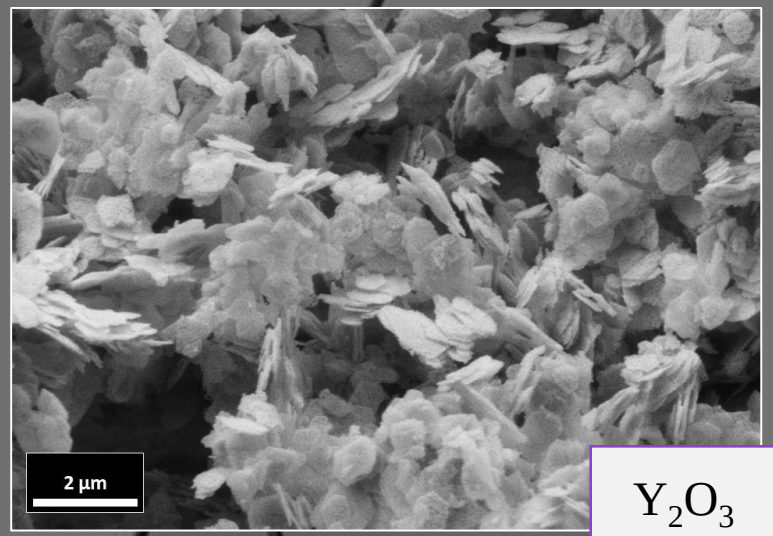
316L/1wt% Y_2O_3



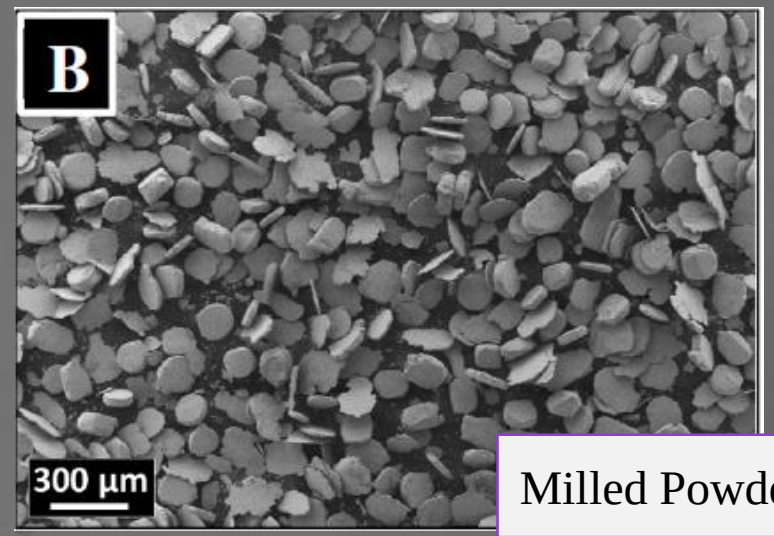
316L/ 1 wt% Y_2O_3



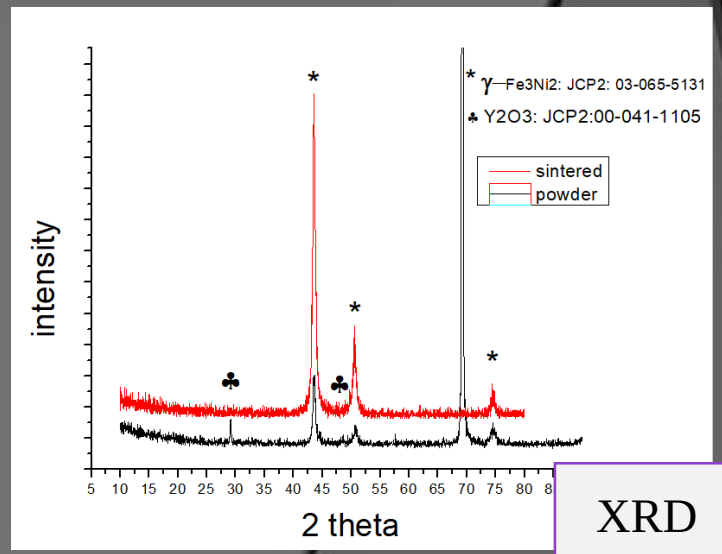
316L Starting Powder



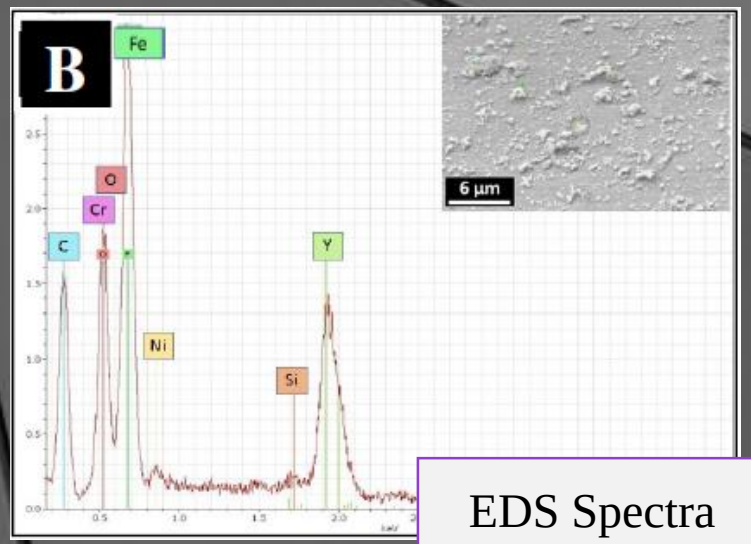
Y_2O_3



Milled Powders



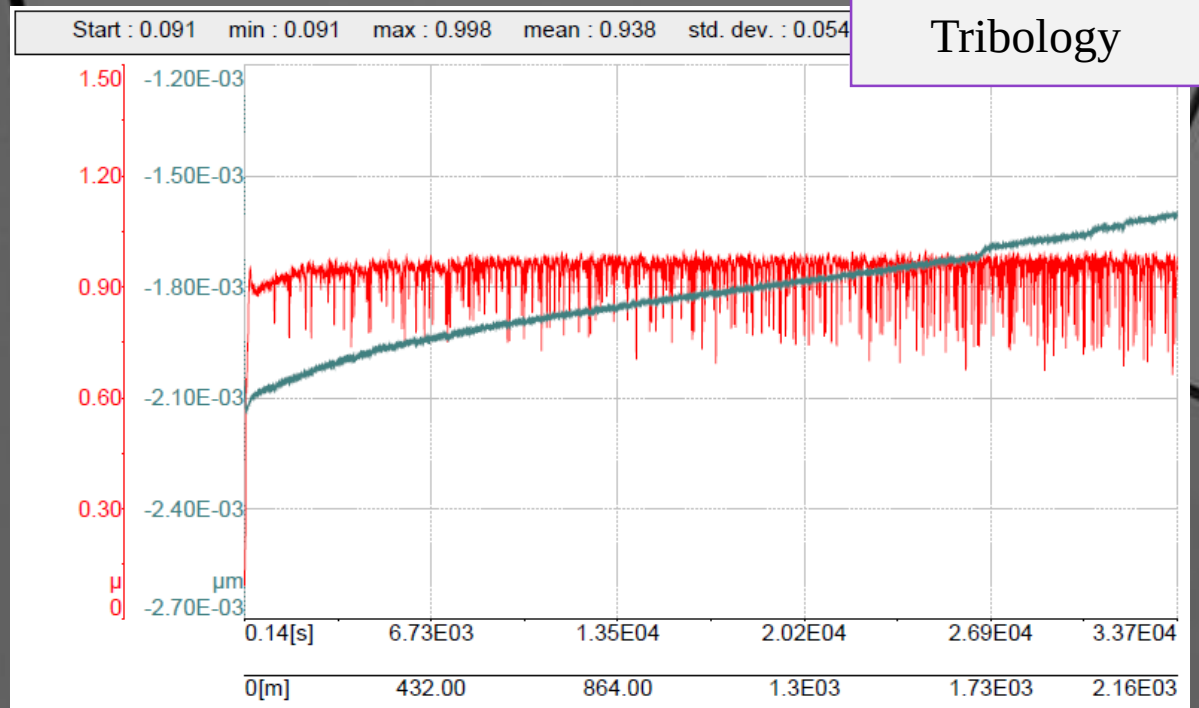
XRD

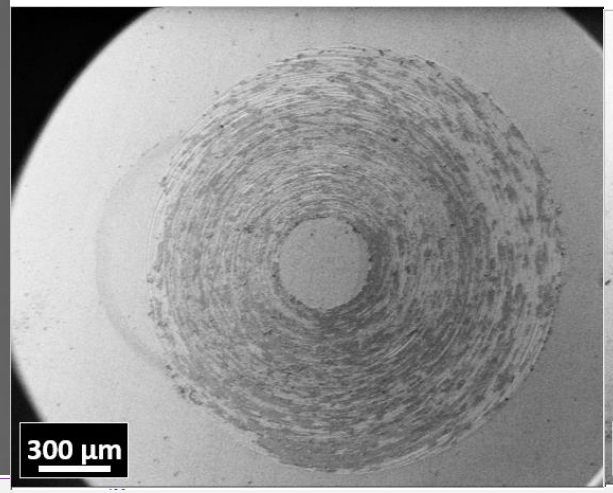


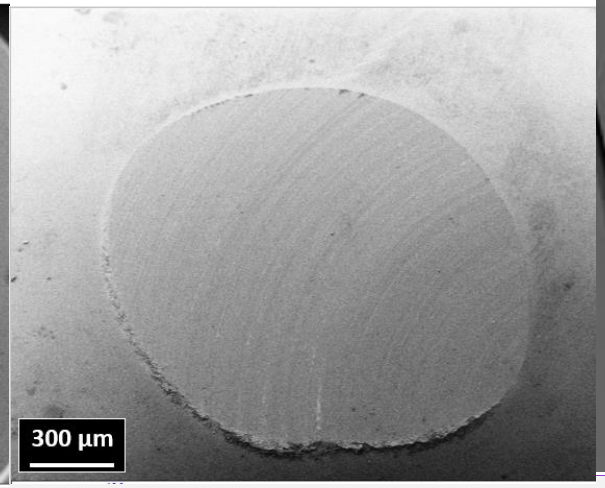
EDS Spectra

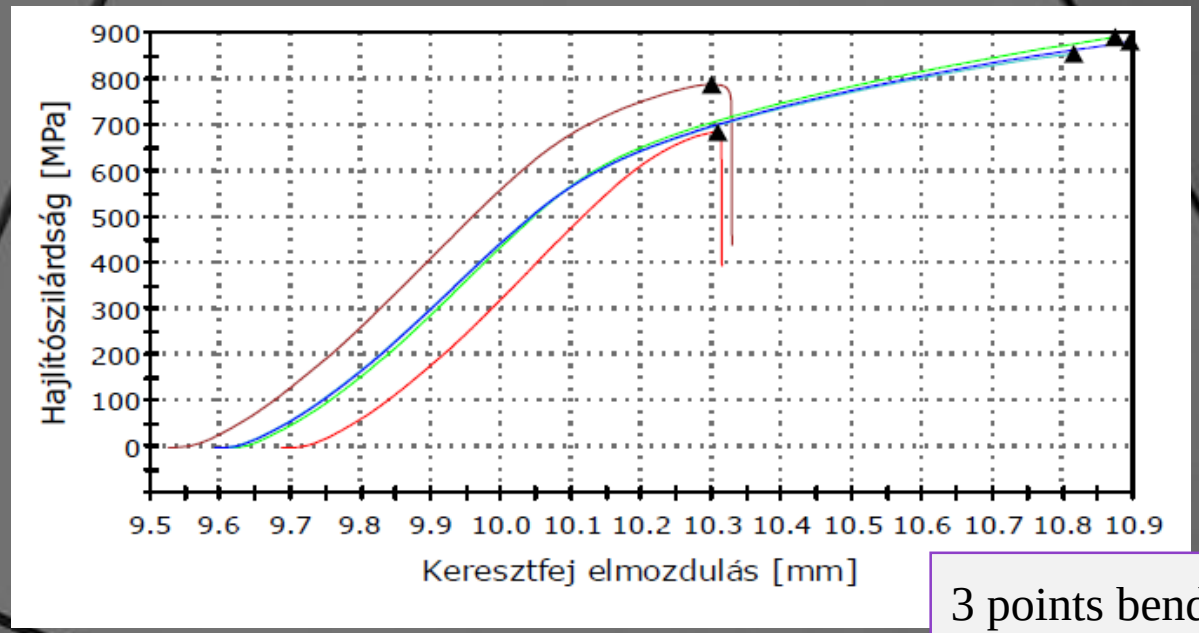
316L/ 1 wt% Y_2O_3

Tribology



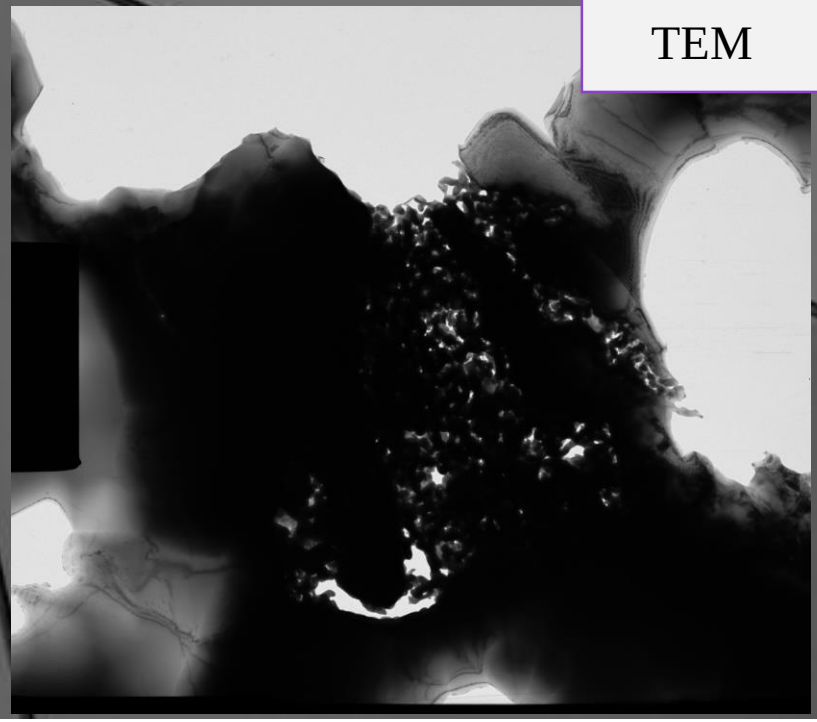






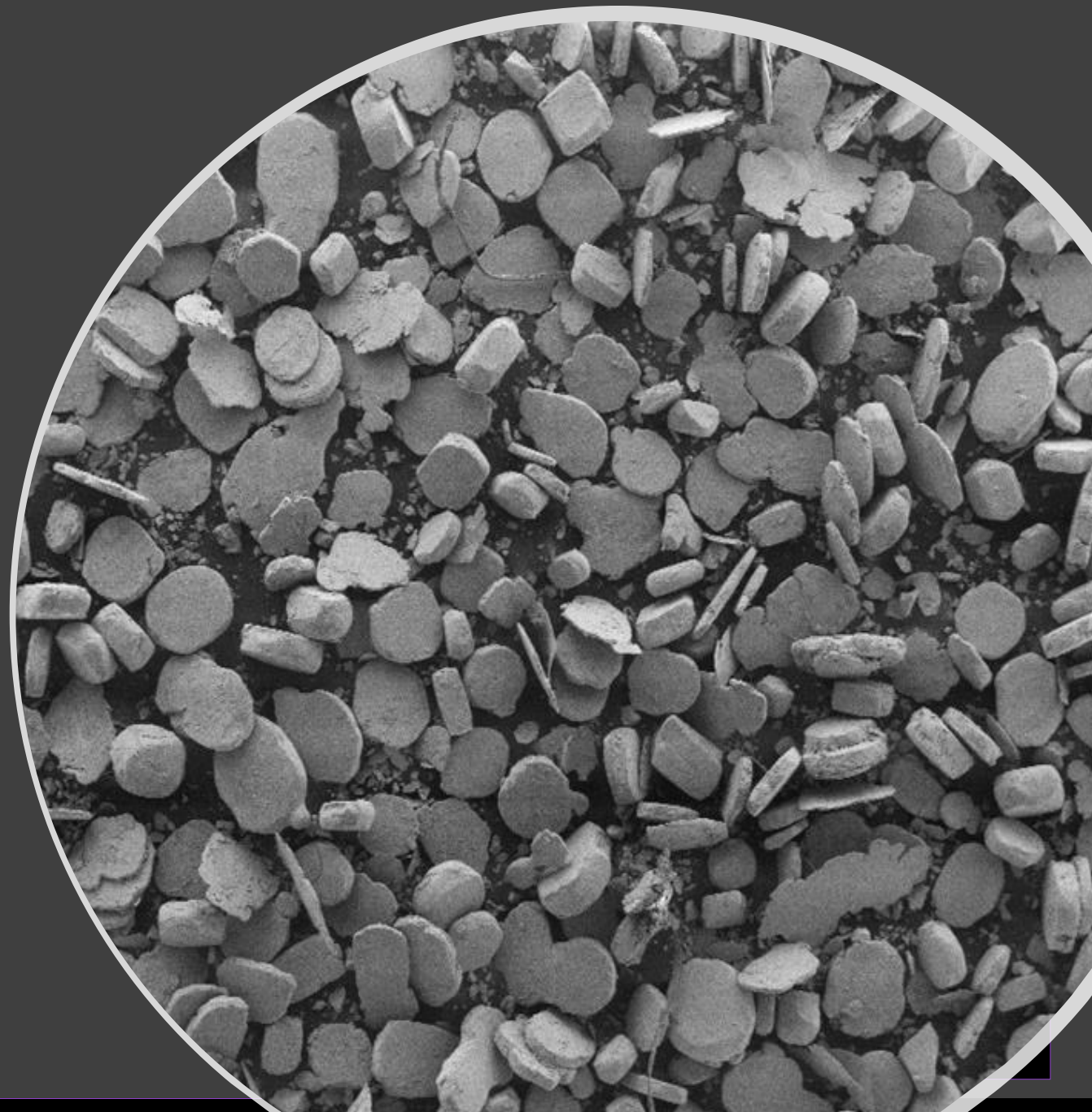
3 points bending test

TEM

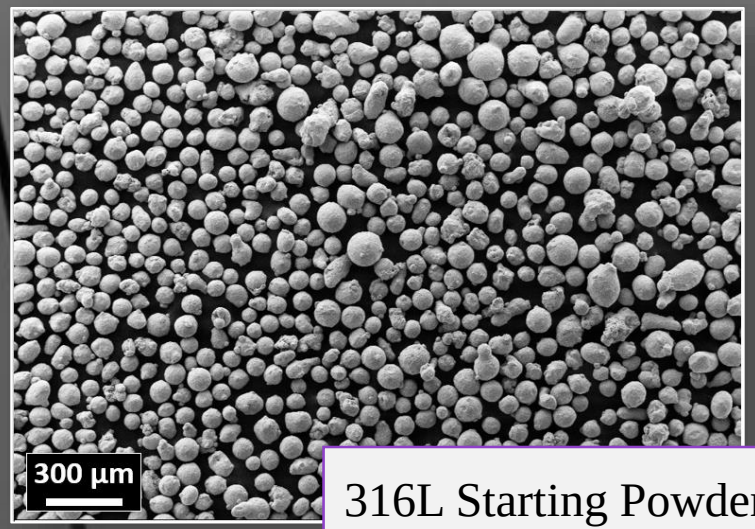


Average Density =7.85

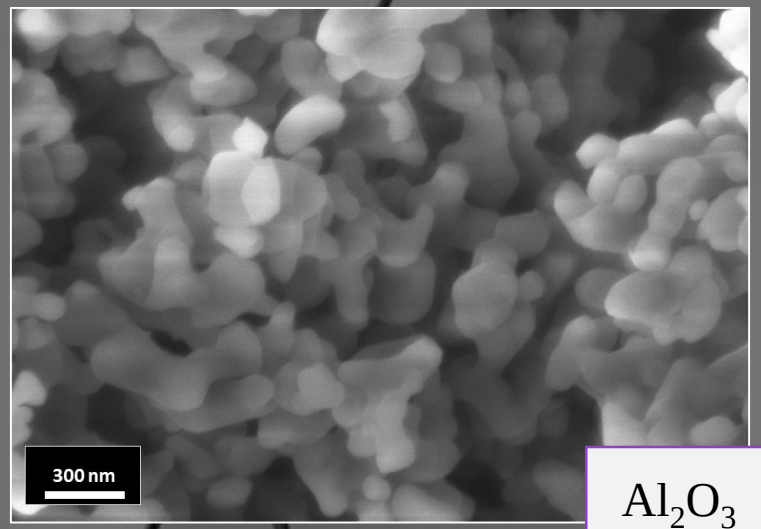
316L/0.33wt% Al_2O_3



316L/ 0.33 wt% Al_2O_3

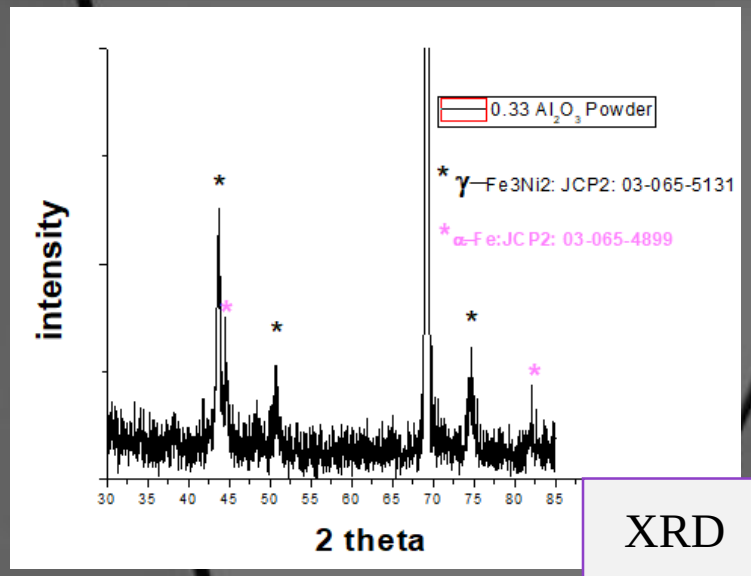


316L Starting Powder

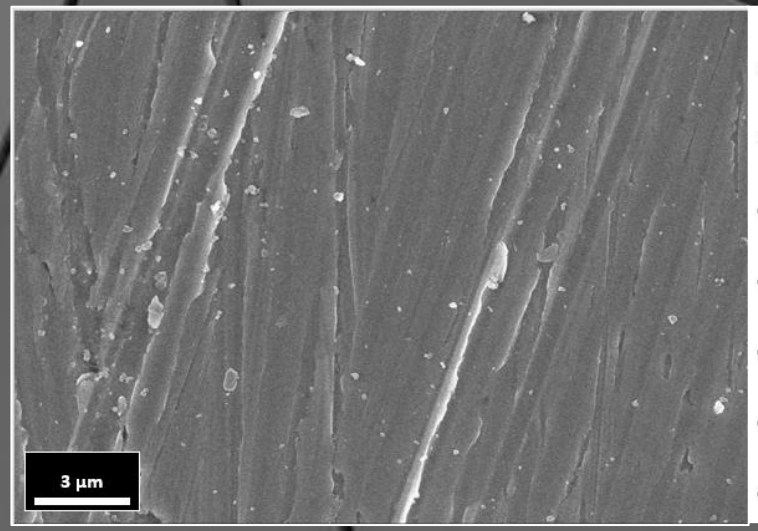


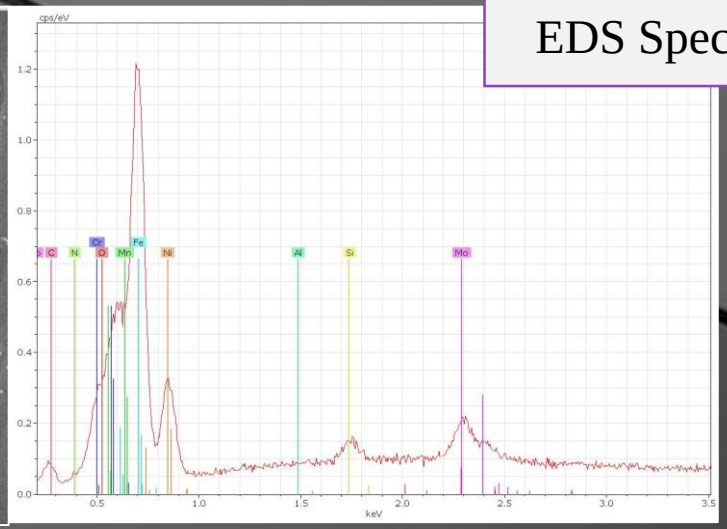
Al_2O_3

Milled Powders



XRD

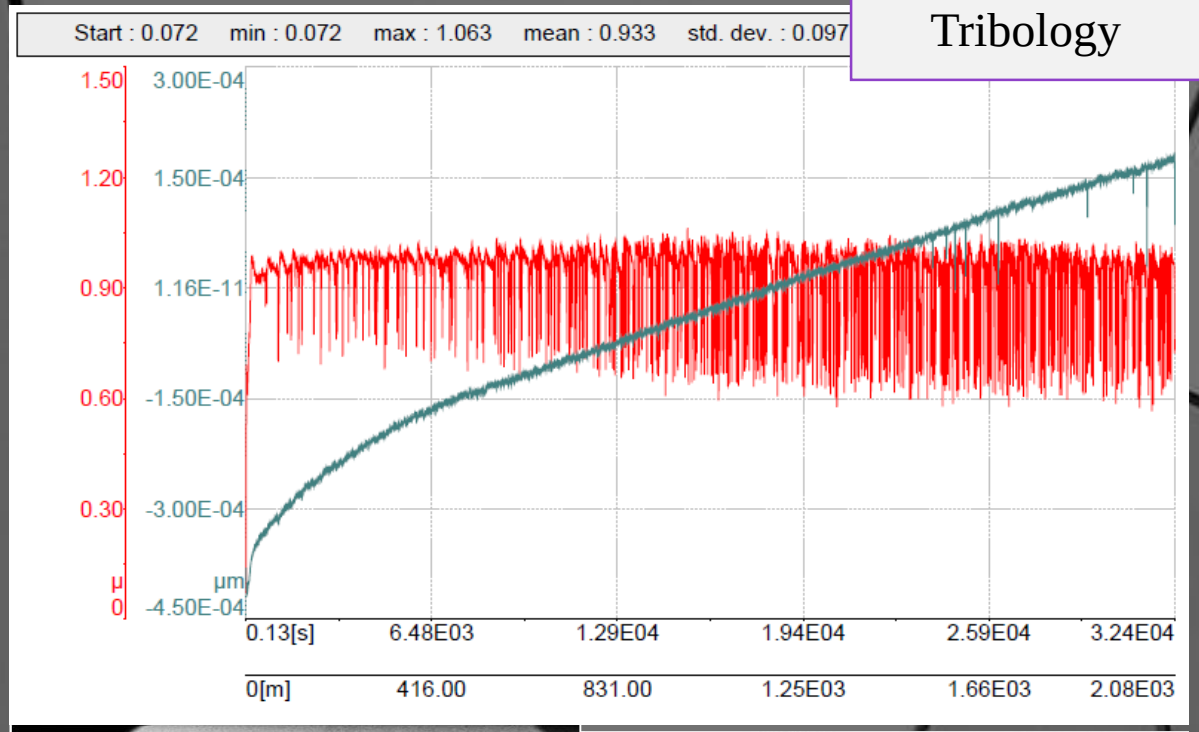


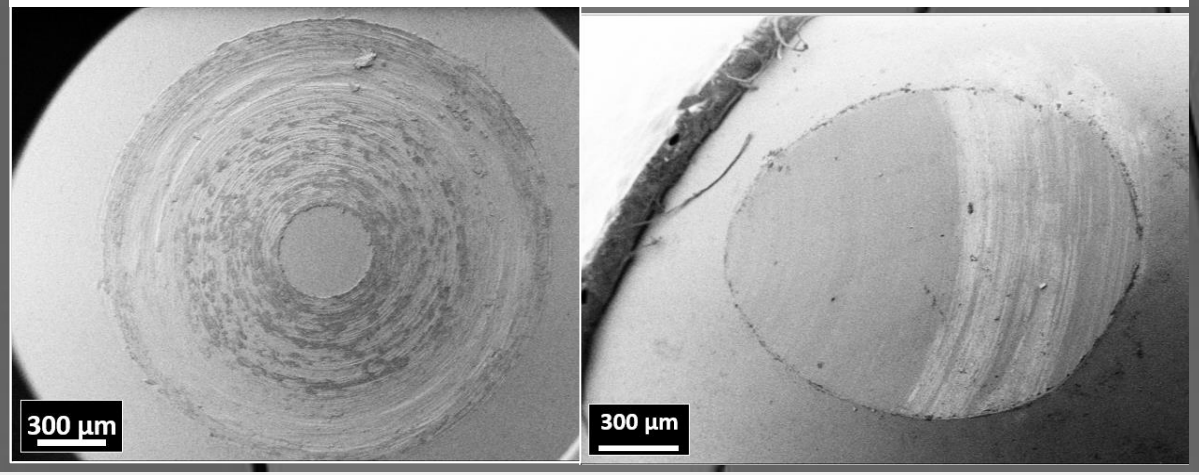


EDS Spectra

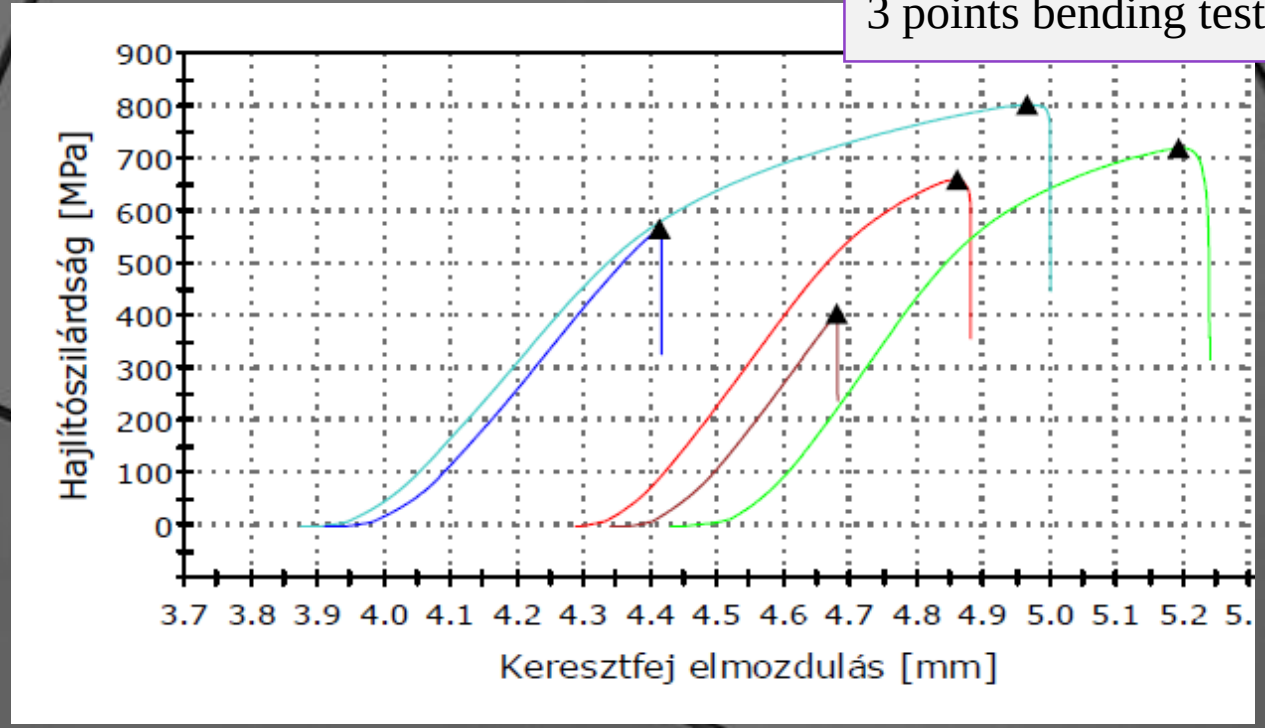
316L/ 0.33 wt% Al_2O_3

Tribology





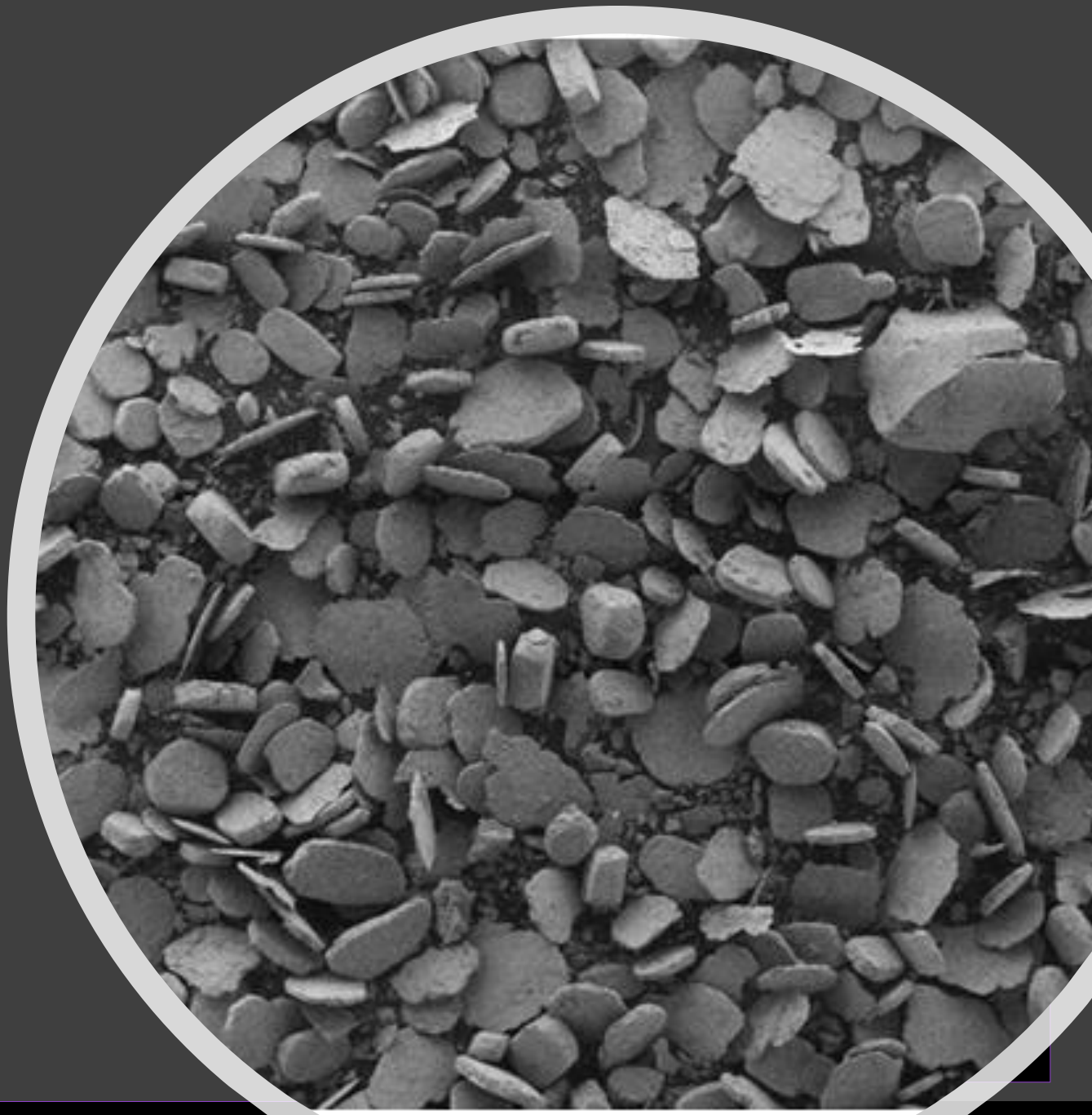
3 points bending test



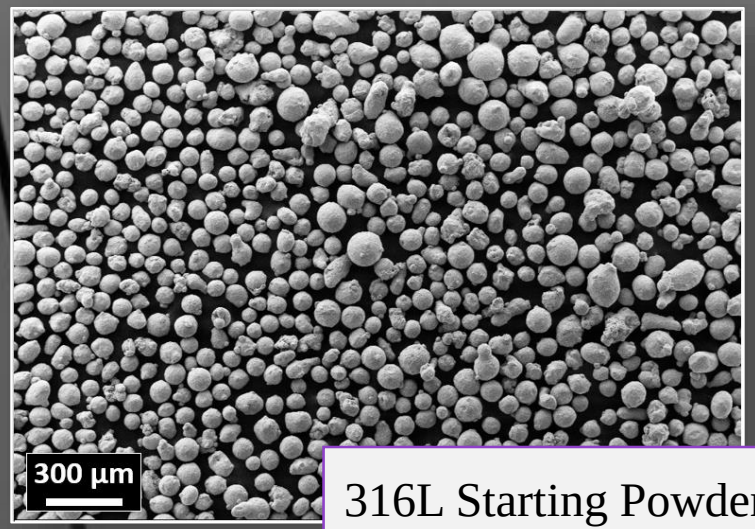
Average Density = 7.83

Average HV= 229.5 ± 0.16

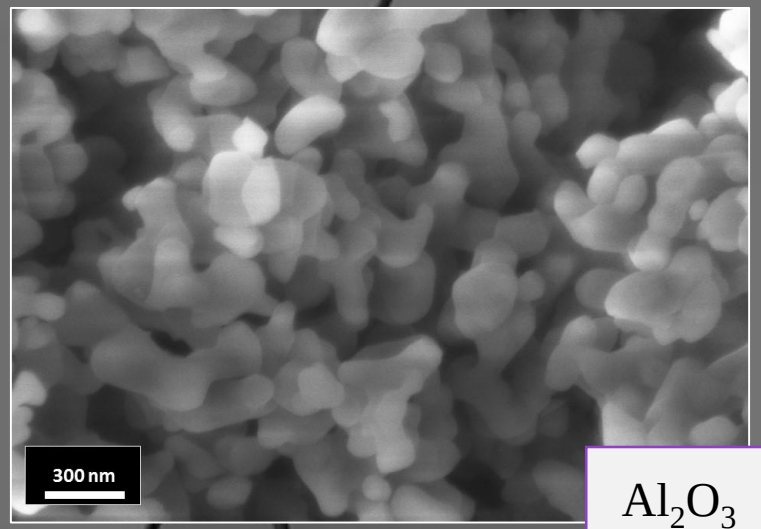
316L/1wt% Al_2O_3



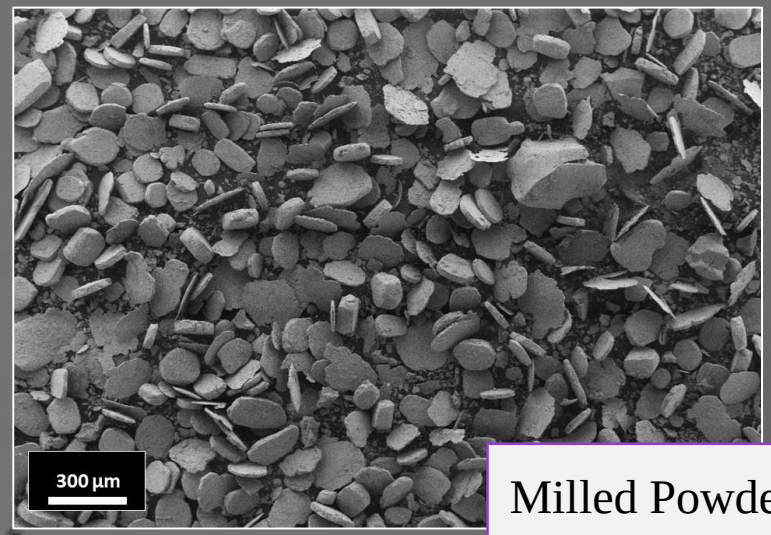
316L/ 1 wt% Al_2O_3



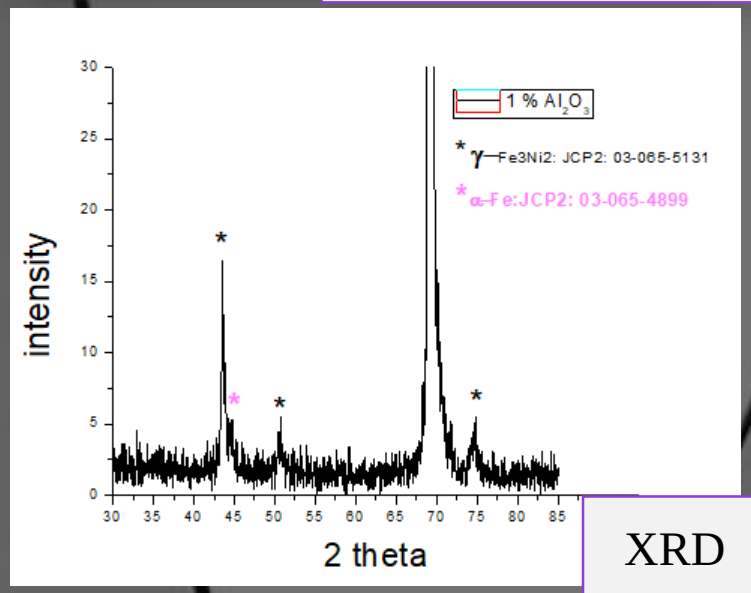
316L Starting Powder



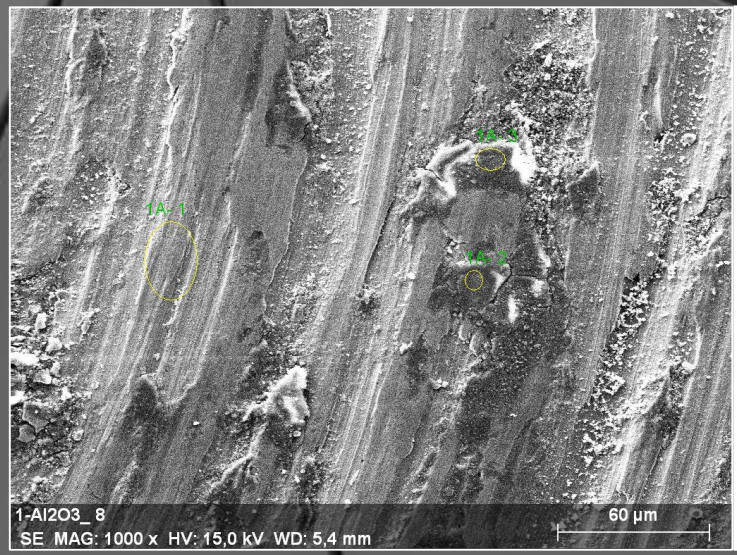
Al_2O_3

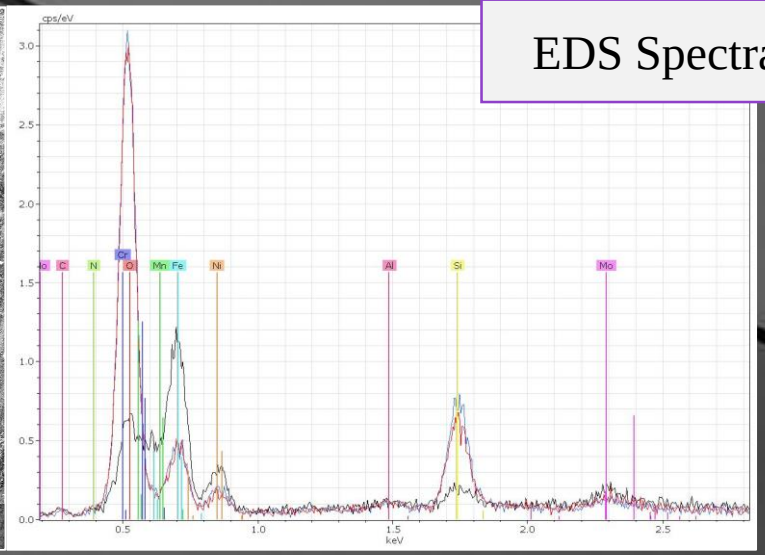


Milled Powders



XRD

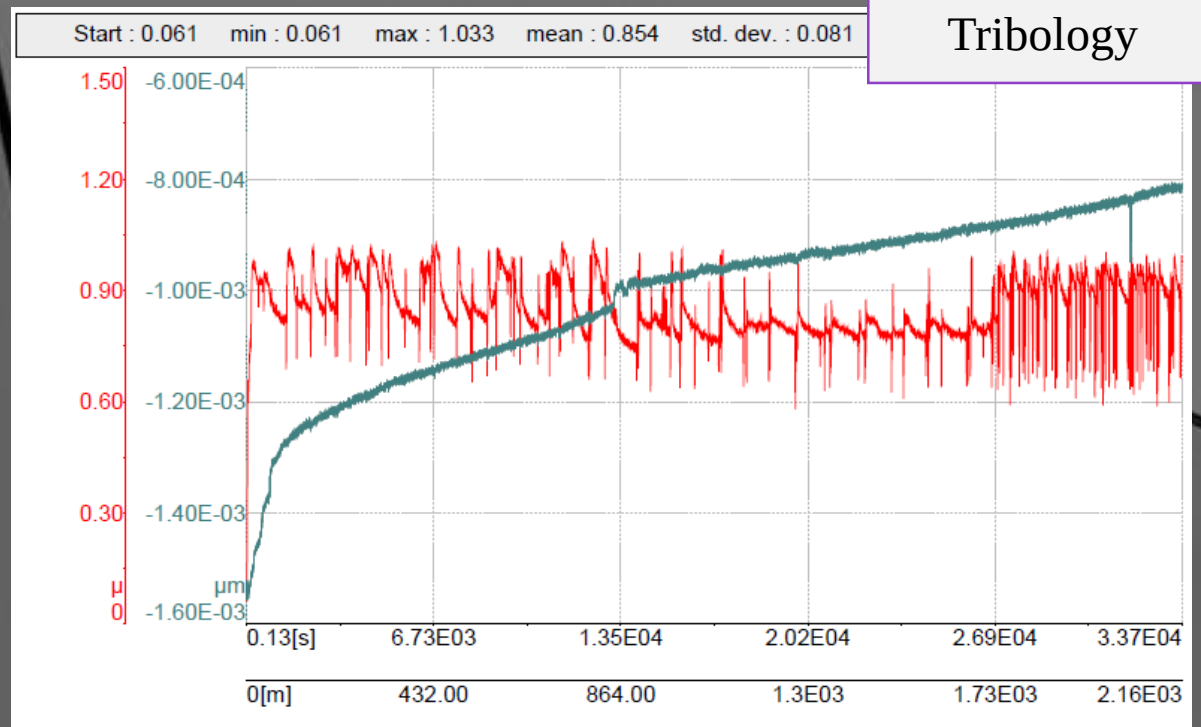


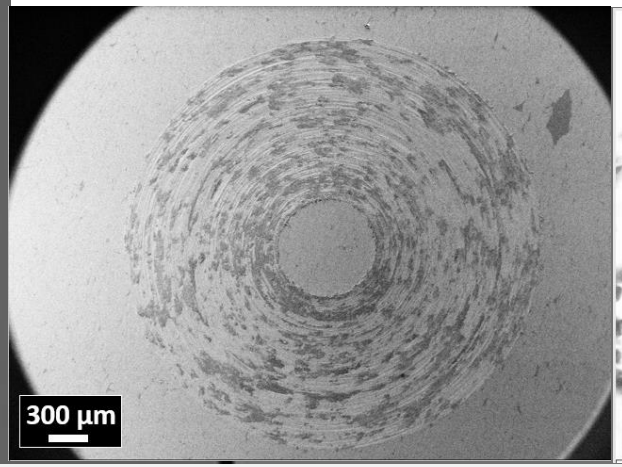


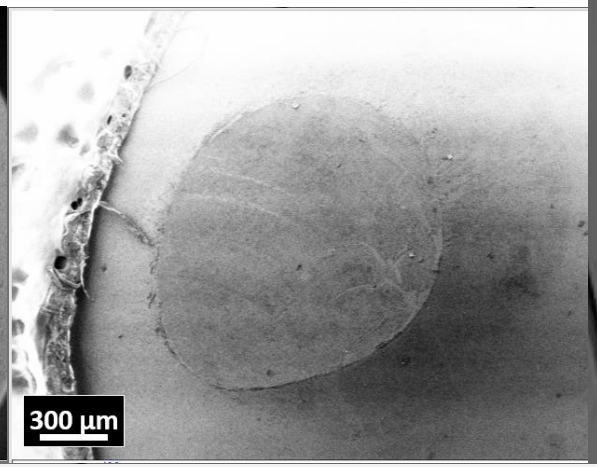
EDS Spectra

316L/ 1 wt% Al_2O_3

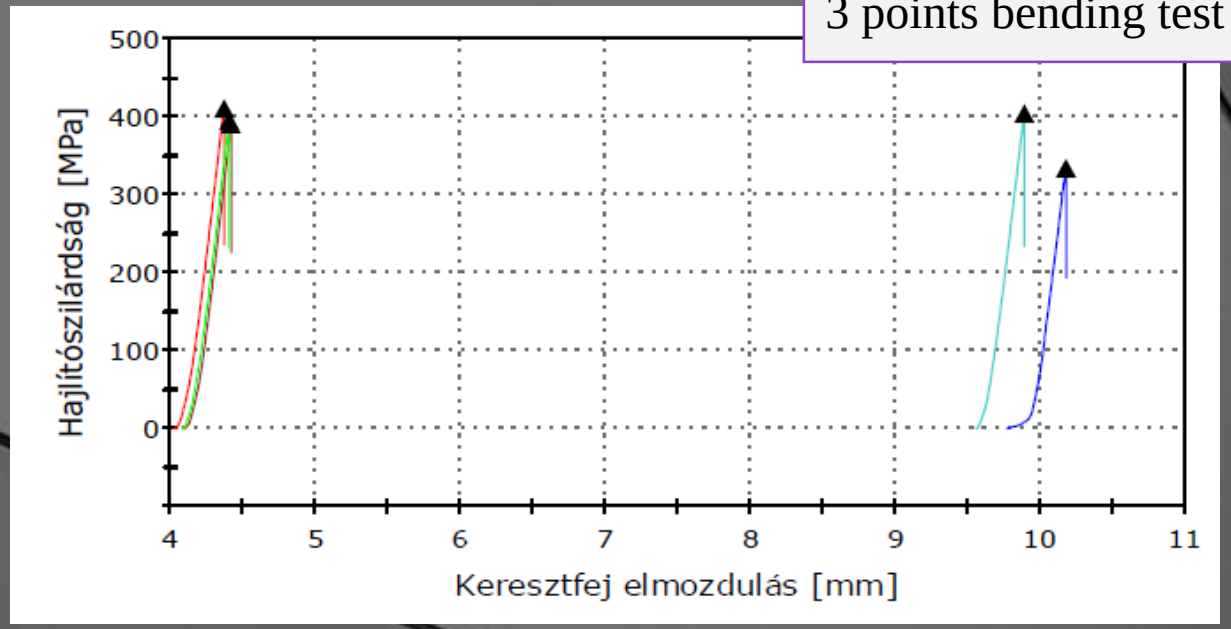
Tribology







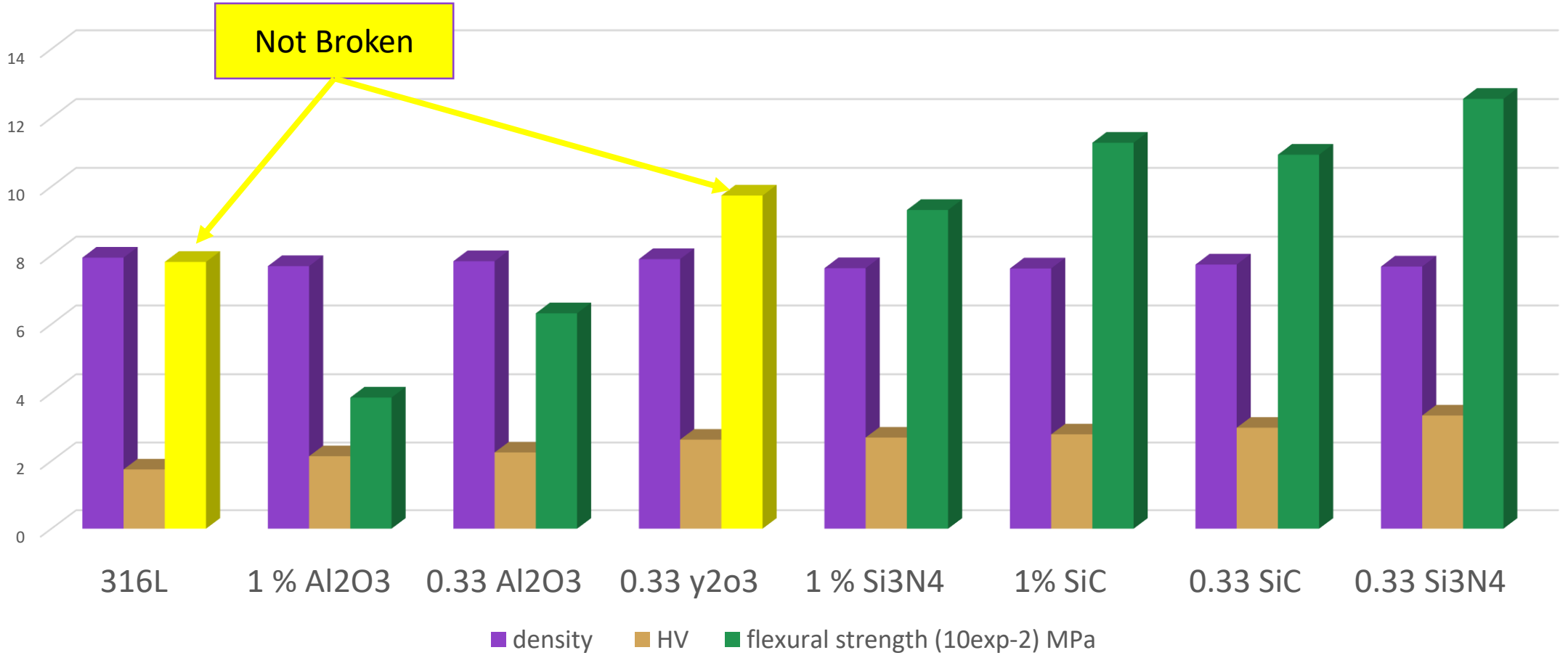
3 points bending test



Average Density = 7.68

Average HV= 218.3 ± 0.17

comparison according to Hardness



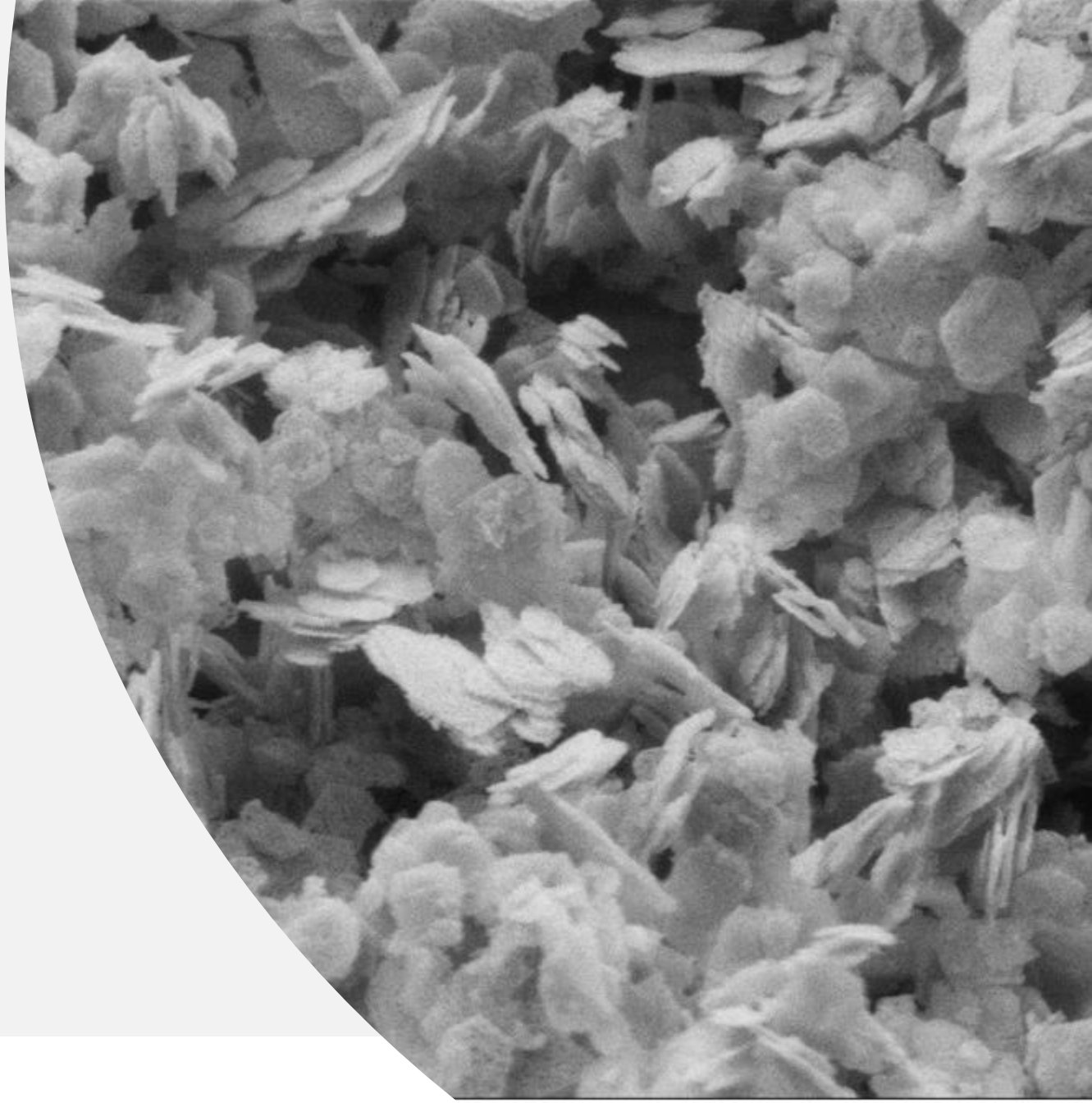
Summary

the elaboration and characterization of 8 composites have been successful

particiting in the “Fine ceramics day” event of Hungarian Scientific Society of Silicate Industry, of April 2018, MTA EK, Budapest, Hungary (ORAL PRESENTATION)

Pablishing 2 papers in Anyagok Világa

participating in FEMS Junior EUROMAT 2018 (July 8-12)



Achievements

Publications abroad with IF (EN):

H.R. Ben Zine, A. Horváth, K. Balázsi, C. Balázsi, **Submicron sized sintered ODS steels prepared by high efficient attritor milling and spark plasma sintering**, COURRIER DU SAVOIR 24: pp. 93-100. (2017) (U**IF Journal: 1.16)**

Publications in Hungary without IF (EN):

H.R. Ben Zine, Filiz Cinar Sahin, Zsolt E Horváth, Zsolt Czigány, Ákos Horváth, Katalin Balázsi, Csaba Balázsi, **Effect of Si3N4 addition on the morphological and structural properties of the 316L stainless steel for nuclear applications**, RESOLUTION AND DISCOVERY 2 (2017) 8

H.R. Ben Zine, Balázsi Katalin, Balázsi Csaba, **EFFECT OF THE α-Si3N4 ADDITION ON THE TRIBOLOGICAL PROPERTIES OF 316L STAINLESS STEEL PREPARED BY ATTRITION MILLING AND SPARK PLASMA SINTERING**,Anyagok Világa (Materials World) 1 (2018) 9-16

H.R. Ben Zine, Balázsi Csaba, Balázsi Katalin, **Study of the Different Ceramic additions effect on the 316L morphological properties during attrition milling** , Anyagok Világa (Materials World) 1 (2018) 36-43

Achievements

Presentations abroad (EN):

H.R. Ben Zine, C. Balázsi, K. Balázsi, A. Horváth, '' SIXIEME ECOLE SUR LES TECHNIQUES DE CARACTERISATION DES MATERIAUX '' In Biskra University12-13 March 2016, Algeria

H.R. Ben Zine, C. Balázsi, K. Balázsi, A. Horváth, Development of nanostructured ODS steels by powder technology, NEA International Workshop on Structural Materials for Innovative Nuclear Systems, 11-14 July 2016, Manchester, UK.

H, R. Ben Zine, Zs. Cigány, F. S. Cinar, Á. Horváth, K. Balázsi, C. Balázsi, the first seminar on "thin films and their applications" at Mohamed khider University, Biskra in Algeria, the 16/04/2017.

H, R. Ben Zine, Zs. Cigány, F. S. Cinar, Á. Horváth, K. Balázsi, C. Balázsi, Si3N4 dispersion strengthened 316L stainless steels: structural and mechanical properties, International Conference Deformation and Fracture in PM Materials, High Tatras, 2017. Okt.22-25, **Oral presentation**

Presentations in Hungary (EN):

H.R. Ben Zine, F.S. Cinar, O. Yucel, K. Balázsi, A. Horváth, C. Balázsi, **the 14th International Symposium on Novel and Nano Materials, 2016. July 3-8, Budapest**. Preparation and Investigation of Boron Nitride Dispersion Strengthened Steels.

H, R. Ben Zine, Zs. Cigány, F. S. Cinar, Á. Horváth, K. Balázsi, C. Balázsi, **MMT conference in Siofok, 13/05/2017**

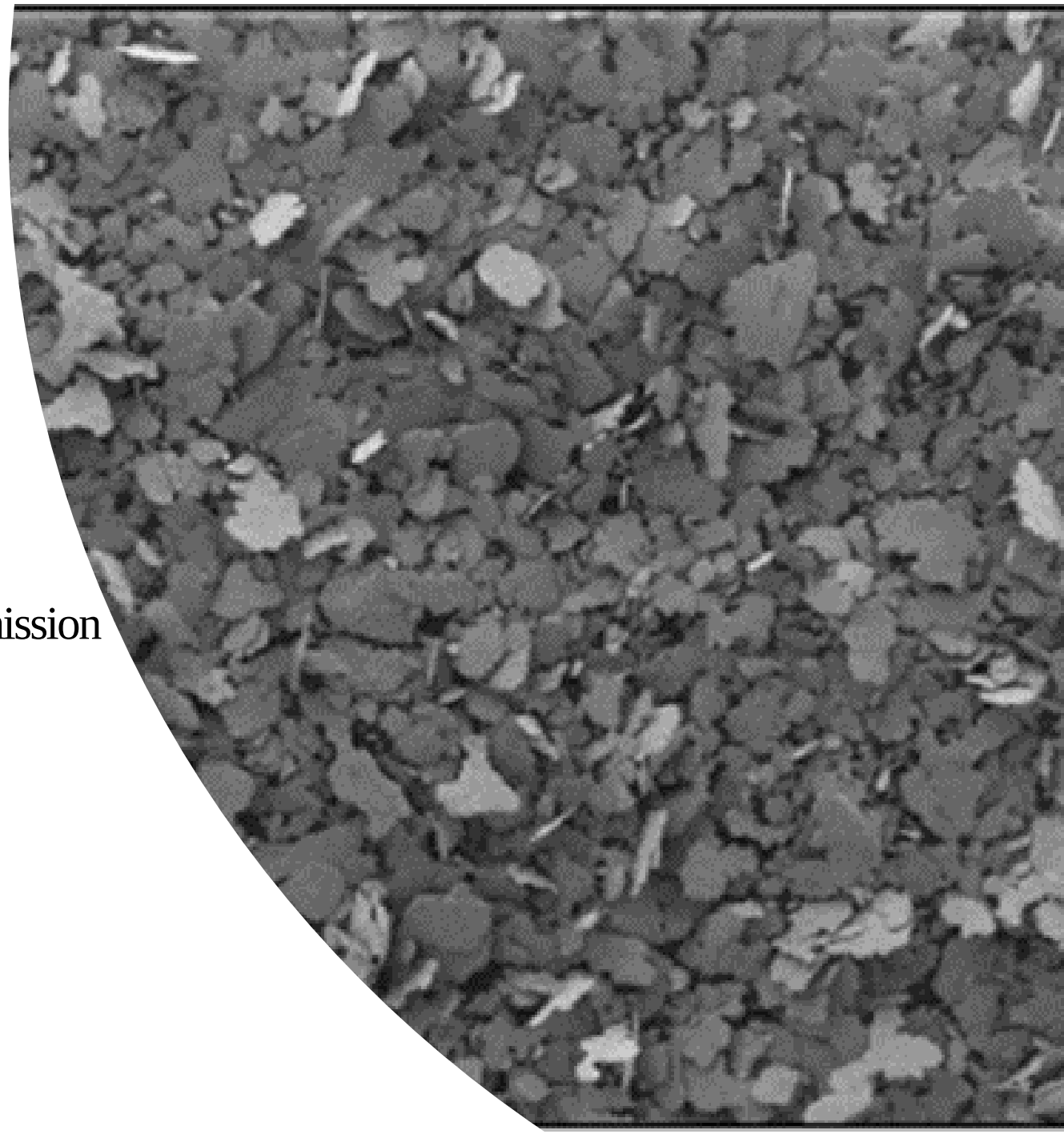
H, R. Ben Zine, Zs. Cigány, F. S. Cinar, Á. Horváth, K. Balázsi, C. Balázsi, **17thPhD Students Materials Science Day"2017. Dec 4,** study of si3n4 addition effect on structural and mechanical properties of the 316l stainless steel, Pannon University, veszprém.

H, R. Ben Zine, Zs. Cigány, F. S. Cinar, Á. Horváth, K. Balázsi, C. Balázsi , **"Fine ceramics day" event of Hungarian Scientific Society of Silicate Industry, of April 2018, MTA EK, Budapest, Hungary**

Presentations in Hungary (HU):

H.R BEN ZINE, Oxid diszpergált rozsdamentes acél előállítása és vizsgálata, **ScIndicator program 07/12/2017**.

Future Plans



- 2IF Articles:
  - 1- materials technology under submission
  - 2- to be ready by the end of July
- getting the Absolutorium in August

- making the final exam

- home deffence

- PhD defence

Thank You