

Preparation and characterization of nanostructured oxide dispersion strengthened steels (ODS)

Semester II

Student:

Mr. BEN ZINE Haroune Rachid

Supervisors:

**Dr. BALÁZSI Csaba
Dr. BALÁZSI Katalin**



Presentation Plan

- Short summary about the last semester
- Experimental work I
- Experimental work II
- Summary about the actual semester
- Plans for future work

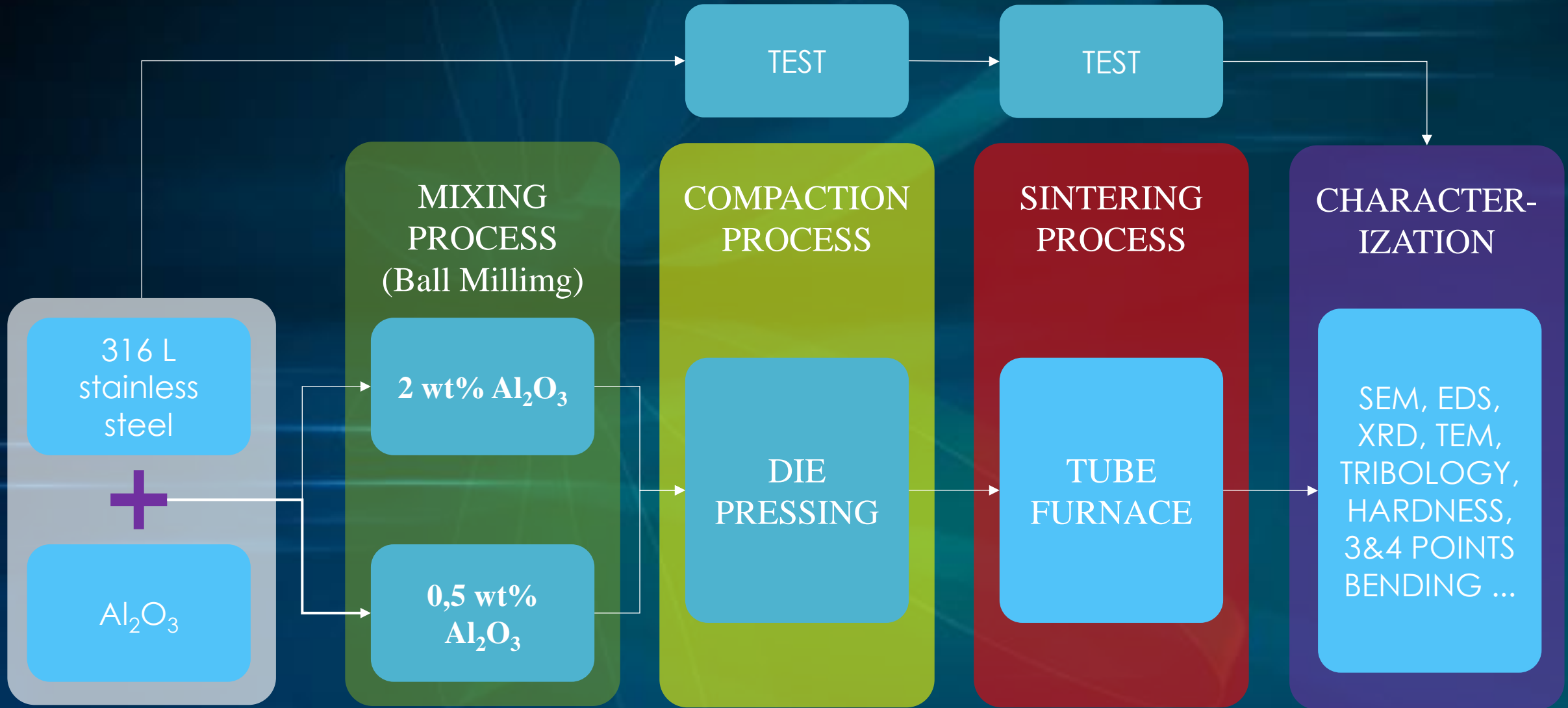
Short summary about the last semester

- 1- Passing all the taken subjects successfully**
- 2- Critical review of literatures about ODS**
- 3- Design a compaction Die for Gleeble 3800**
- 4- Ordering the steel powder from Höganäs**

Experimental Work I

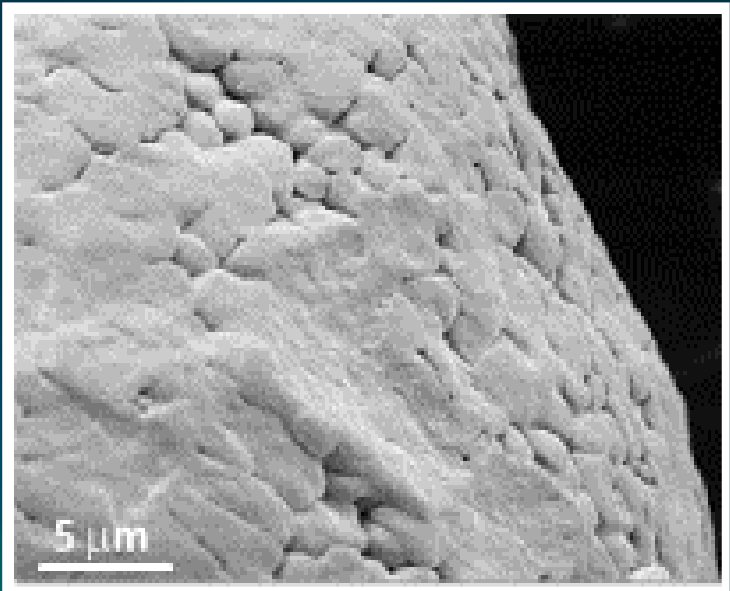
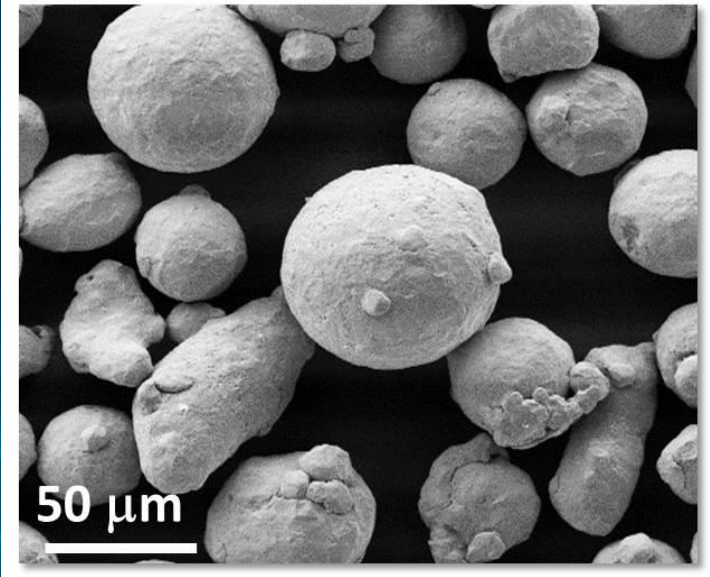
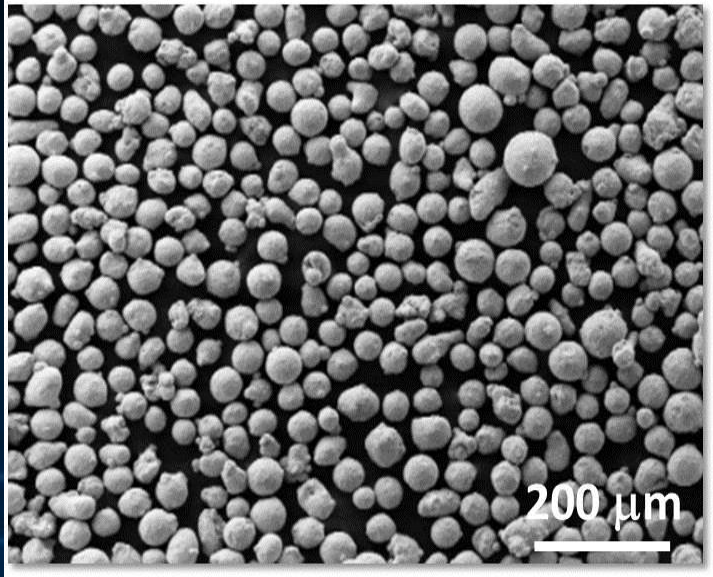
- Ordering 316L Stainless Steel from Hoganas
- Characterization of the 316L powder by **SEM, EDS** and **XRD**
- Defining the parameters for Mixing Process
- Designing of compaction Dies
- Pressing of Hoganas Stainless Steel Powder
- Sintering of the Hoganas stainless steel green samples
- Characterization of the Sintered Samples By SEM, EDS, XRD and Tribology
- Pressing of the milled powder (Hoganas+ Al_2O_3)

Preparation of 316L samples



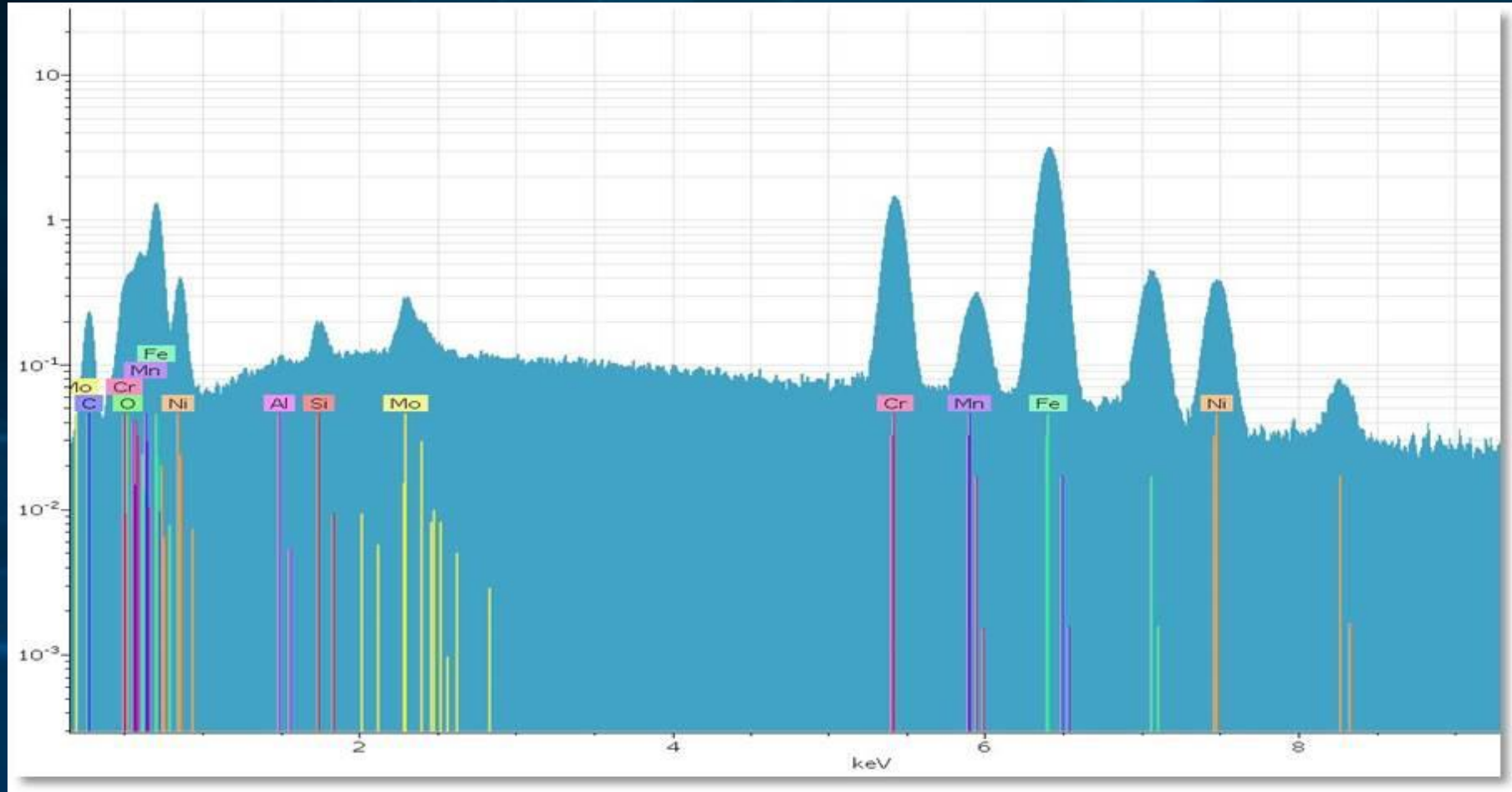


Characterization of the 316L powder by SEM





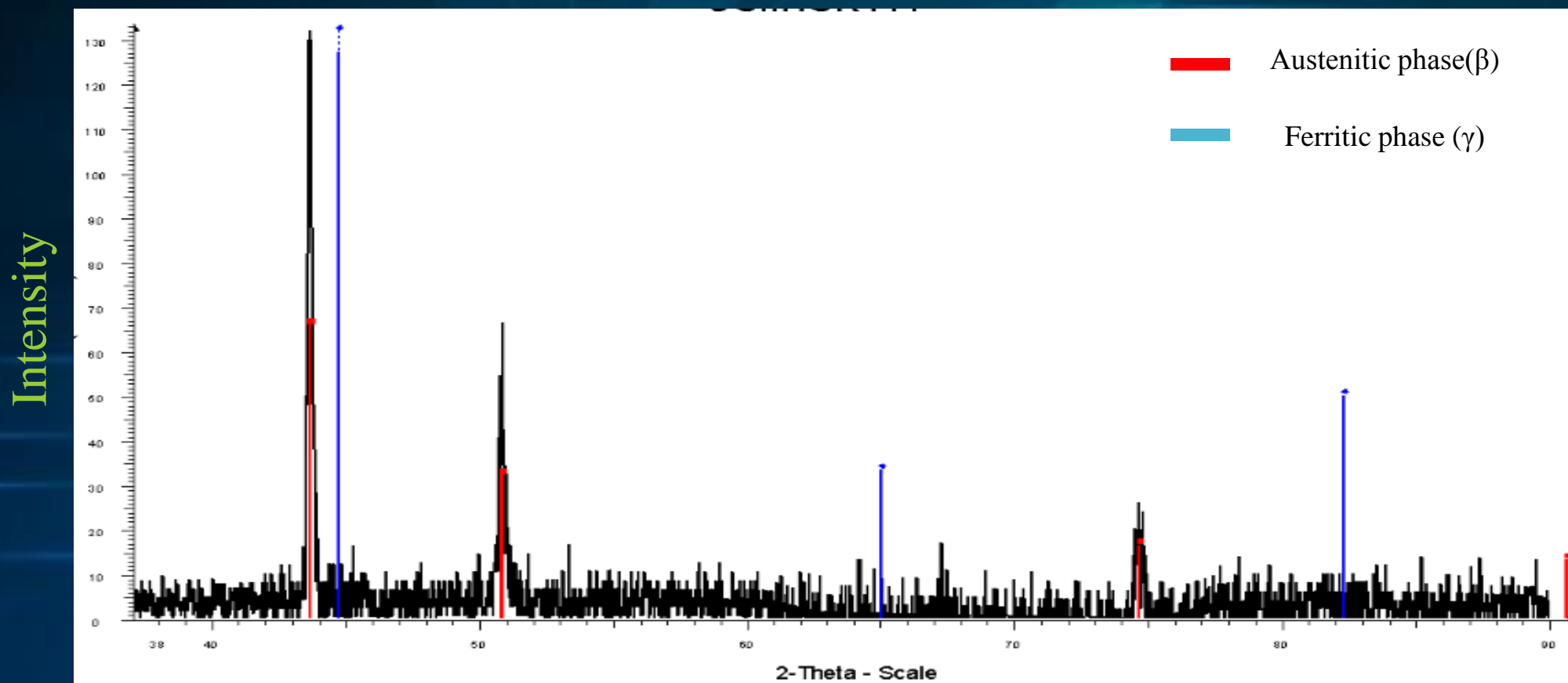
Characterization of the 316L powder by EDS



EDS Results for the 316L stainless steel powder



Characterization of the 316L powder by XRD



2 Theta

Defining the parameters for Mixing Process

A	B	C	D	E	F	G	H	I	J	K
Ball type	Diameter	number of B	V (mm ³)	v (cm ³)	sum of balls V		jar volume		enter the ball weight(g)	balls weight
WC	<input checked="" type="checkbox"/> 10	49	25643,33333	25,64333333	V(mm ³)	V(cm ³)	V(mm ³)	V(cm ³)	8	392
	<input type="checkbox"/> 0	0	0	0	57501,25	57,50125		200	0	0
	<input type="checkbox"/>	0	0	0	V Ratio (B+P)/J				0	0
	<input type="checkbox"/>	0	0	0	61%				0	0
	<input type="checkbox"/> 0	0	0	0	ratio Wt B/P (ref=3)				0	0
	<input type="checkbox"/> 0	0	0	0	3,0875				0	0
	<input type="checkbox"/> 0	0	0	0					0	0
STEEL	<input checked="" type="checkbox"/> 5	167	10924,58333	10,92458333					0,5	83,5
	<input type="checkbox"/> 0	0	0	0					0	0
	<input checked="" type="checkbox"/> 10	40	20933,33333	20,93333333					3,55	142
	<input type="checkbox"/> 0	0	0	0					0	0
	<input type="checkbox"/> 0	0	0	0					0	0
	<input type="checkbox"/> 0	0	0	0					0	0
	<input type="checkbox"/> 0	0	0	0					0	0
									enter the powder volume(cm ³)	
									65	
									enter the powder weight(g)	
									200	

Mixing Process

- Preparation of jars (cleaning)
- Ball Milling
- Taking a Sample every 2 hours for characterization

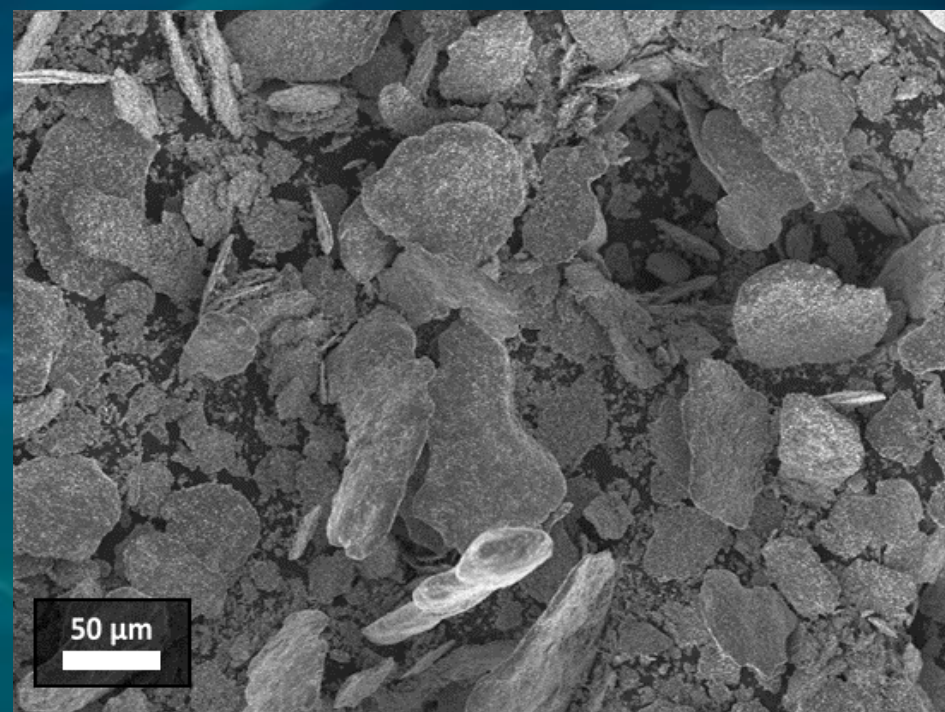


	Jar Volume (cm ³)	Powder weight (g)	Milling speed (rpm)	Milling time
2% wt Al ₂ O ₃	200	200	~400	10 hours
0,5% wt Al ₂ O ₃	200	200	~400	10 hours



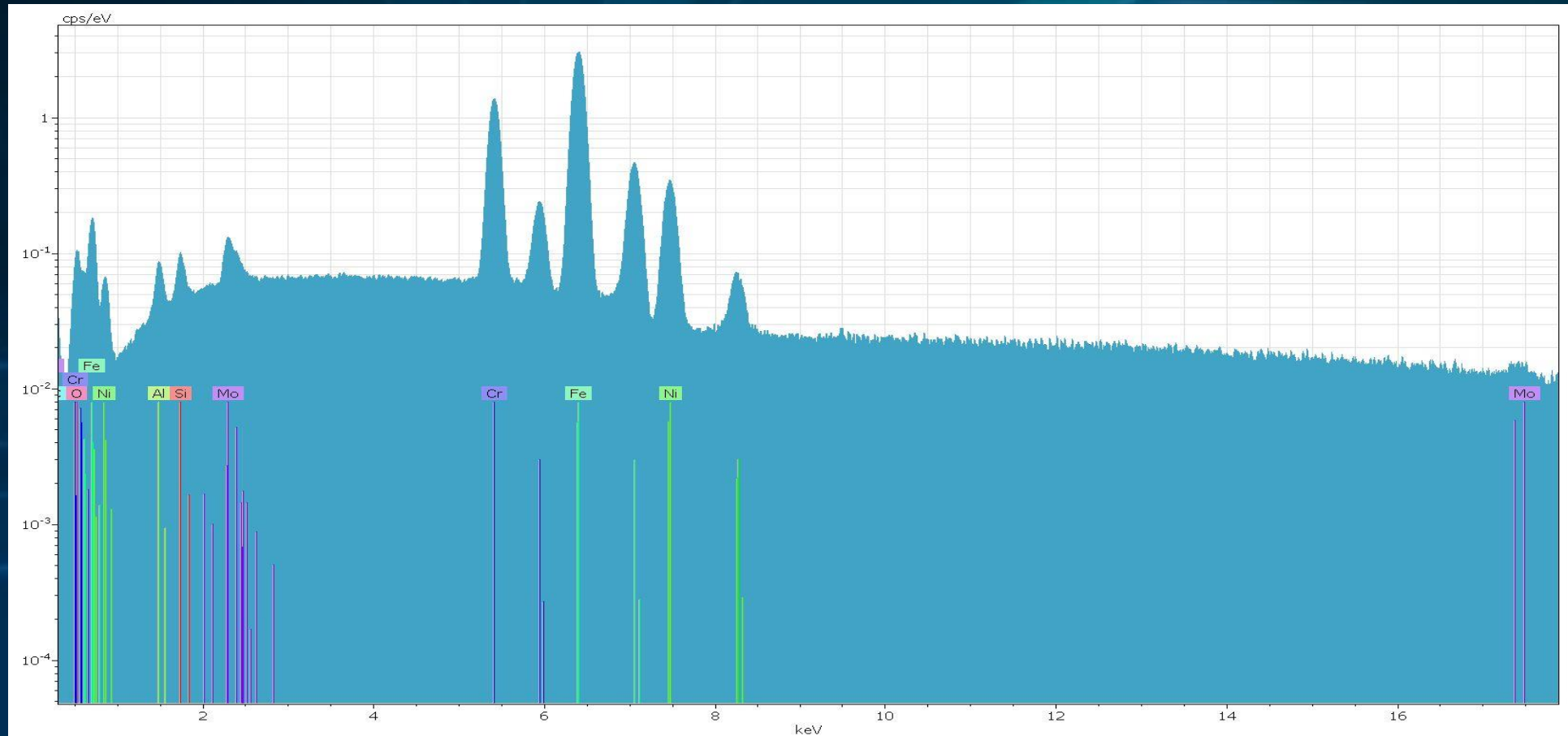
Characterization of the Milled Powders

- SEM pictures of Milled 316L with 0,5 wt% Al_2O_3 powder



Characterization of the Milled Powders

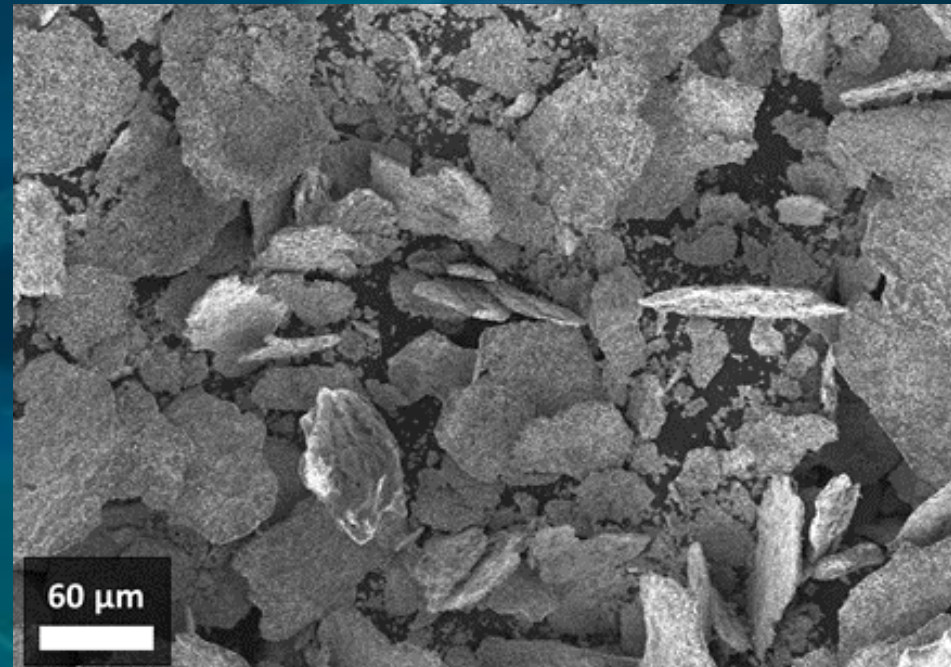
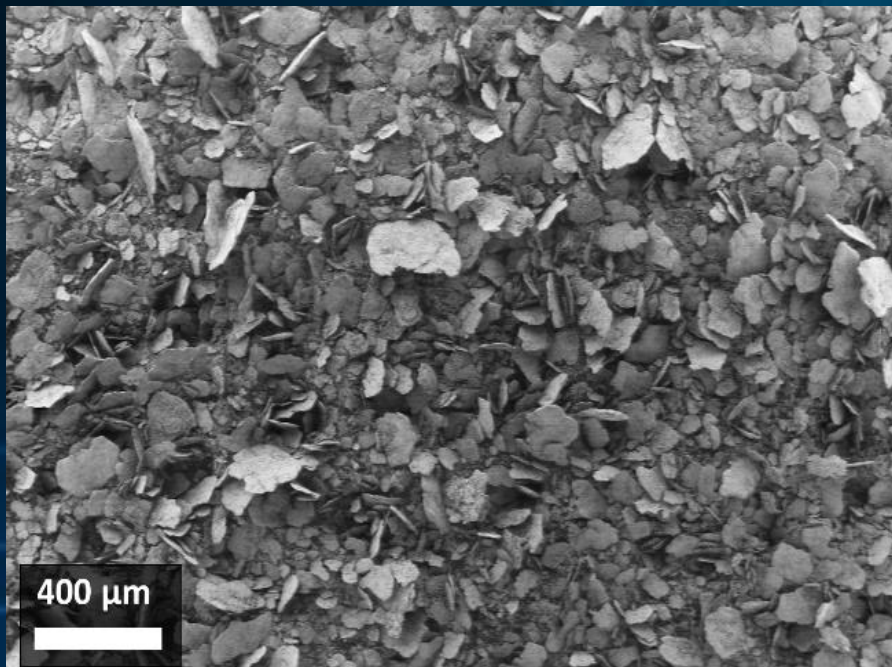
- EDS Spectra of Milled 316L with 0,5 wt% Al_2O_3 powder



Characterization of the Milled Powders



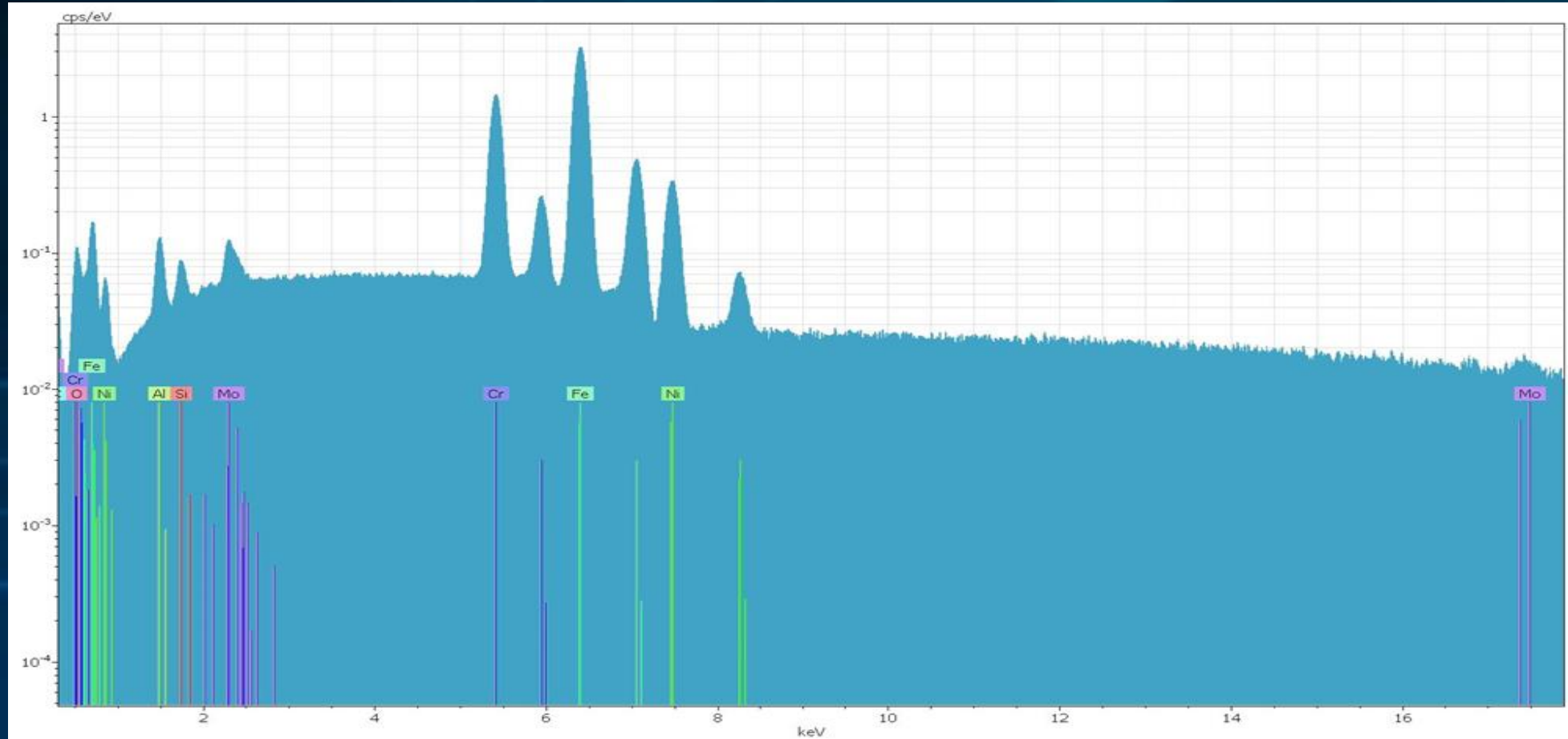
- SEM pictures of Milled 316L with 2 wt% Al_2O_3 powder



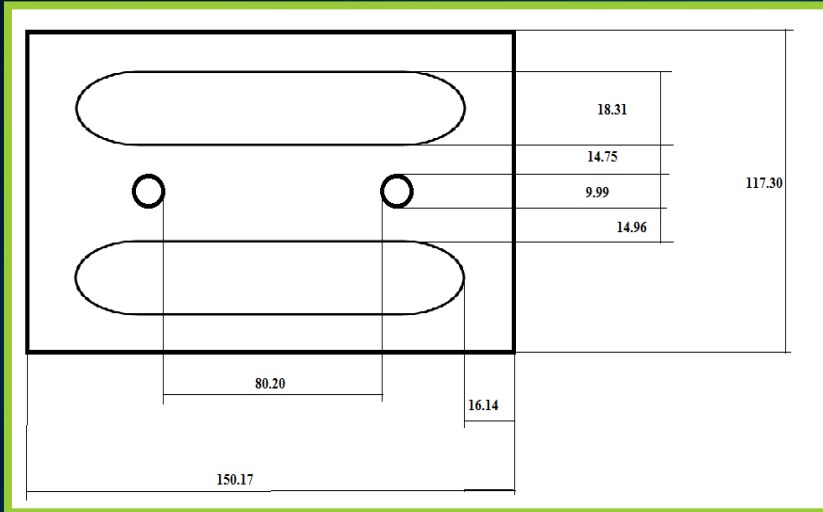
Characterization of the Milled Powders



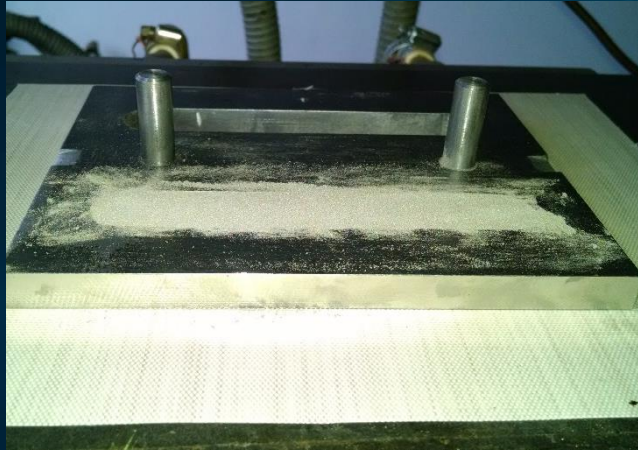
- EDS Spectra of Milled 316L with 2 wt% Al_2O_3 powder



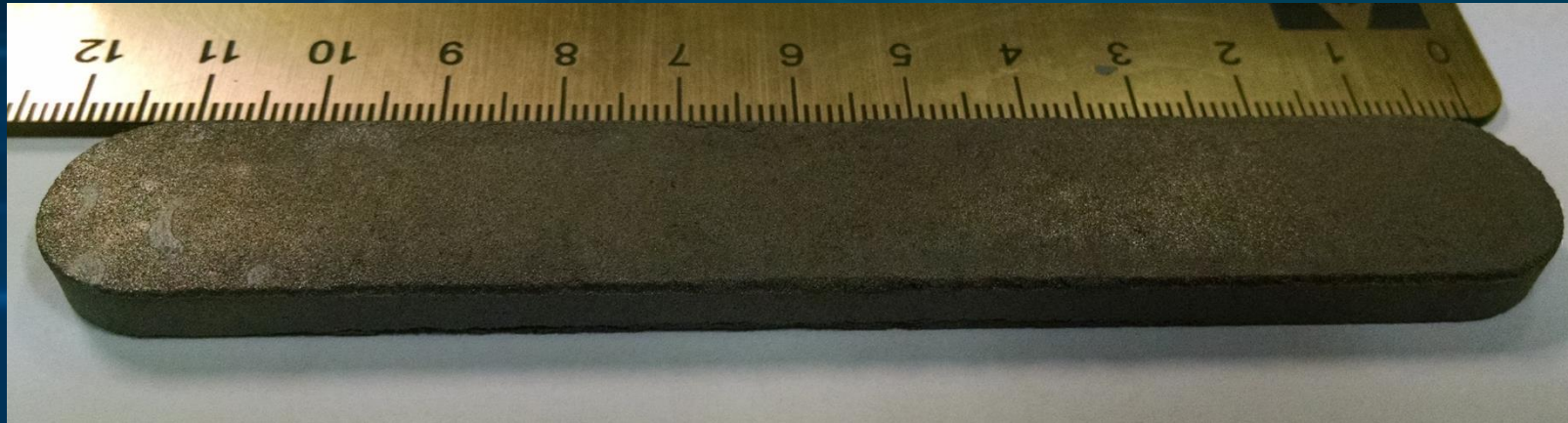
Designing of compaction Dies



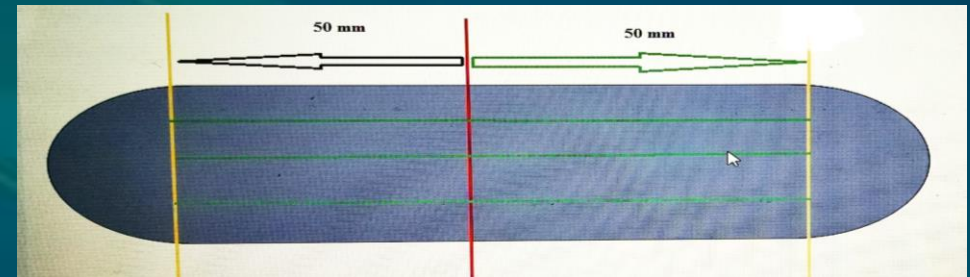
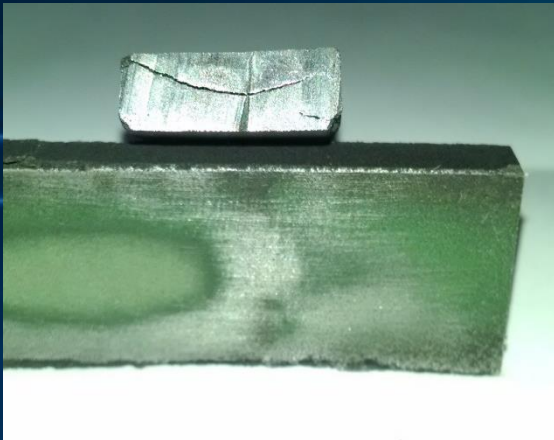
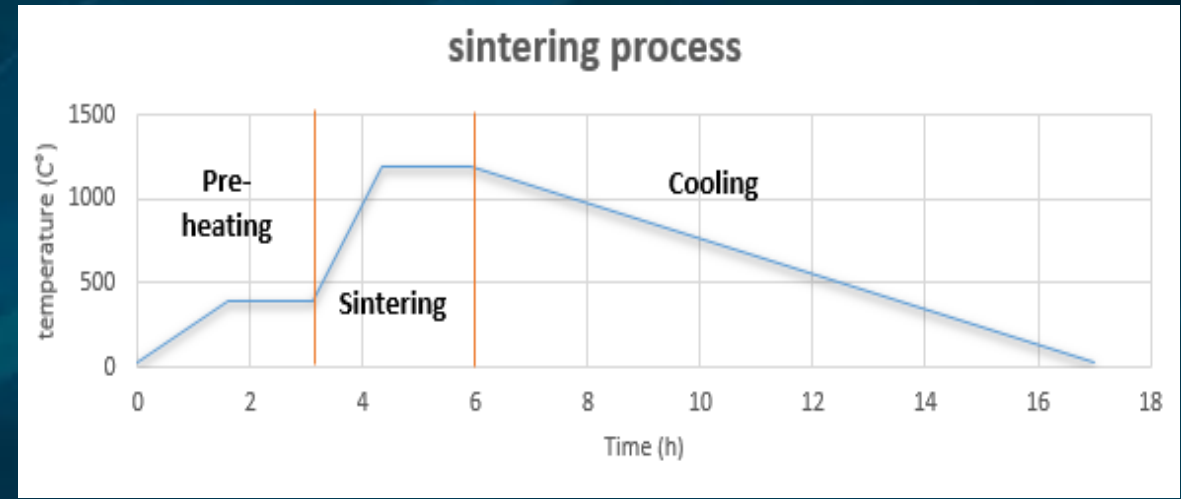
Pressing of Hoganas Stainless Steel Powder

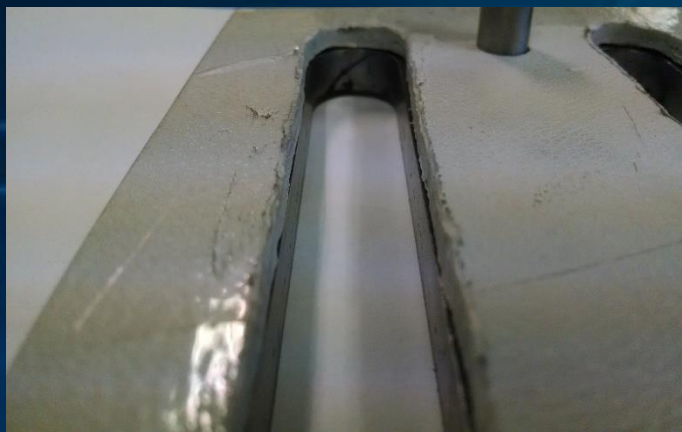


Pressing of Hoganas Stainless Steel Powder



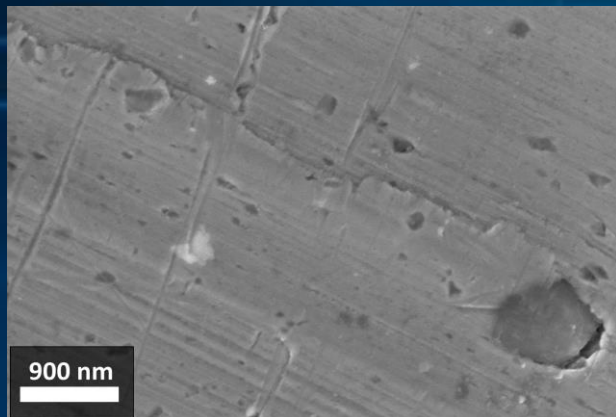
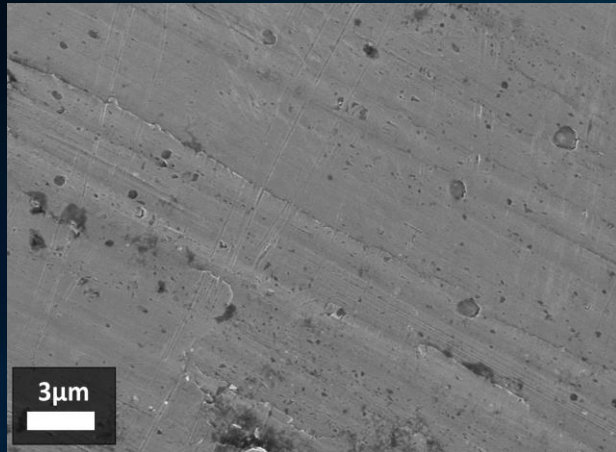
Sintering of the Hoganas stainless steel green samples



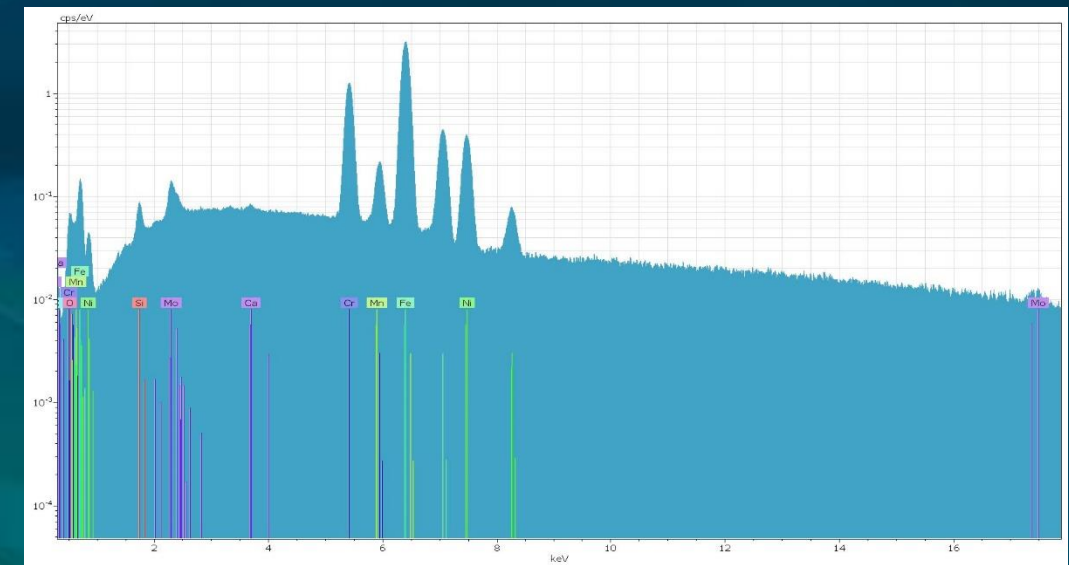
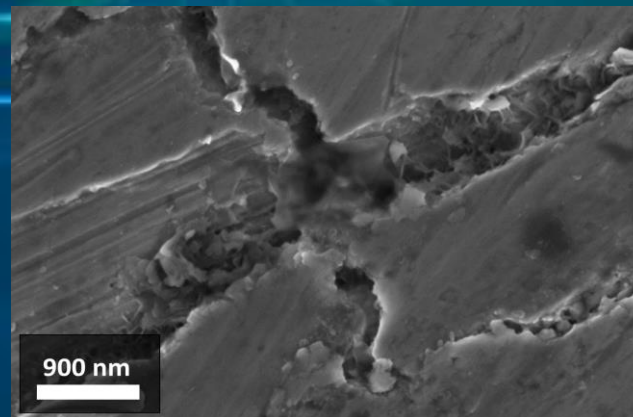
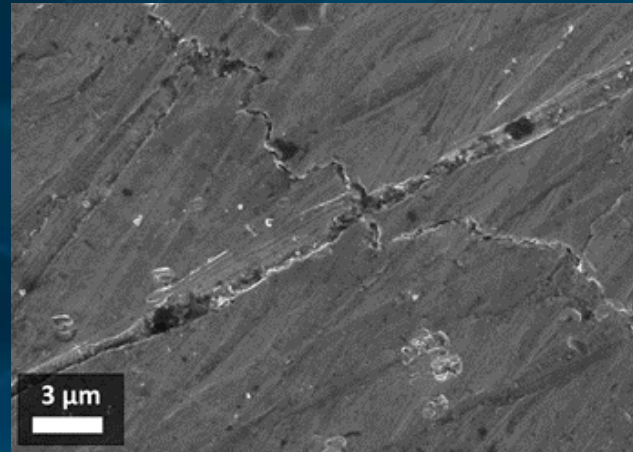


Characterization of the Sintered Samples By SEM and EDS

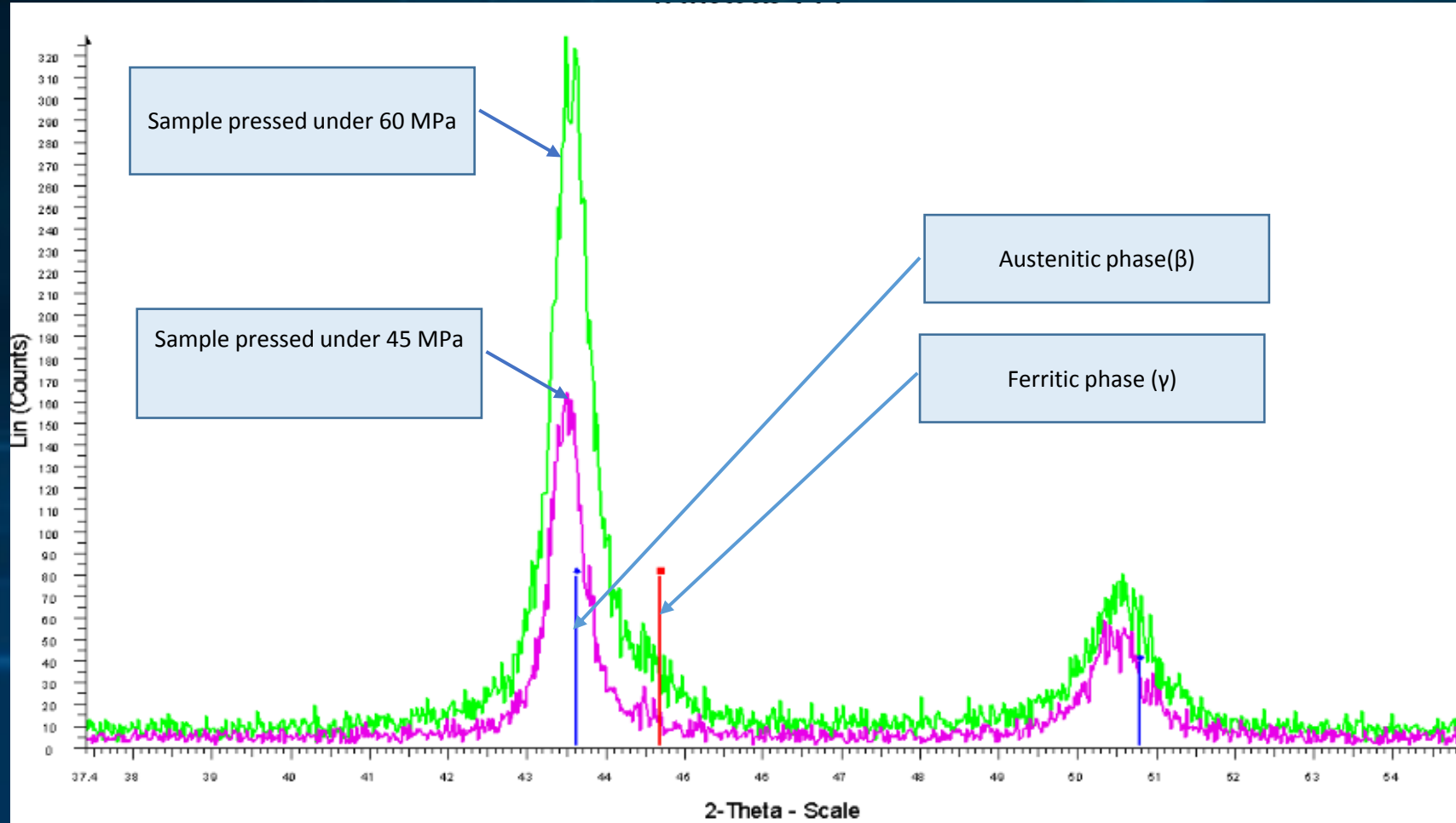
60 MPa



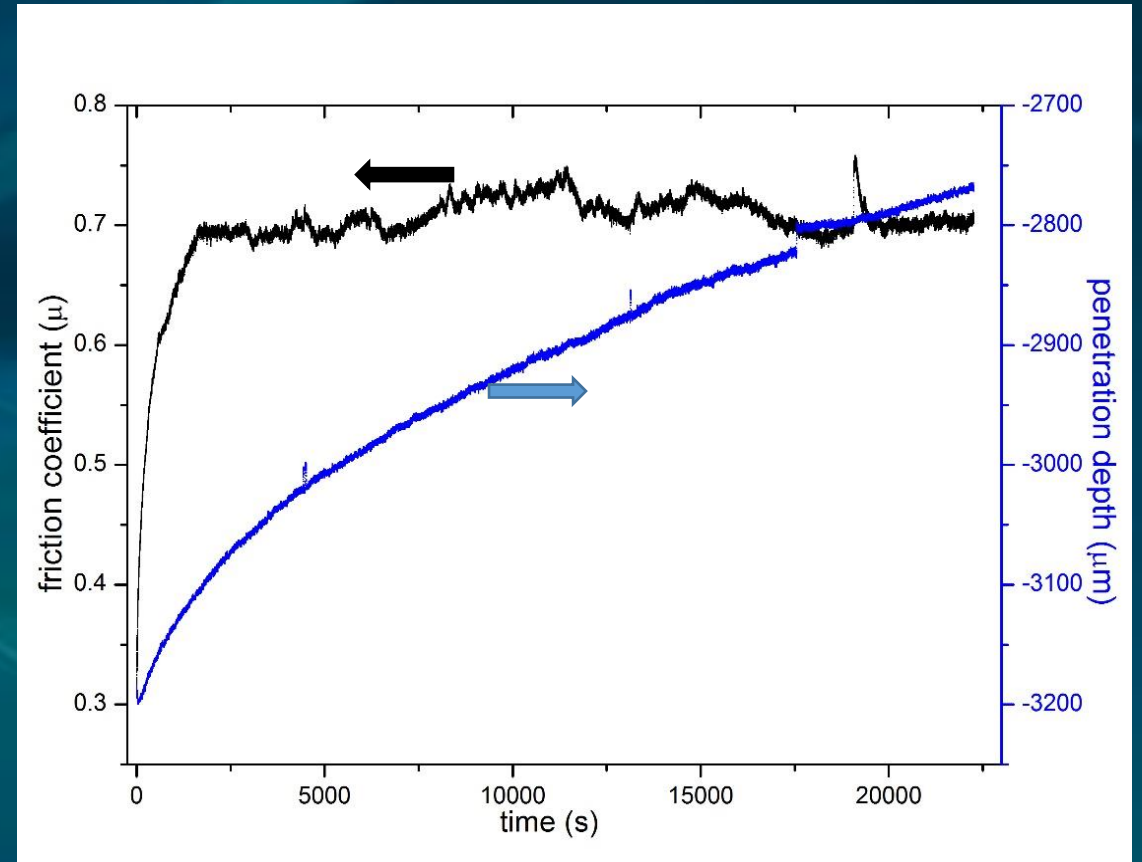
45 MPa



Characterization of the Sintered Samples By XRD



Characterization of the Sintered Samples By Tribology



Pressing of the milled powder (Hoganas+ Al_2O_3)



Composition of Höganäs based composite

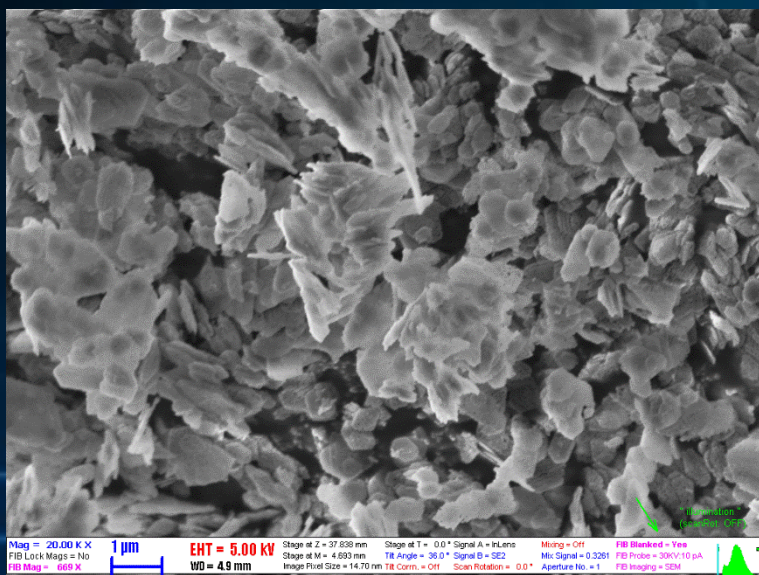
- Höganäs steel powder with **1 %** of Y_2O_3
- Höganäs steel powder with **0.333 %** of Y_2O_3
- Höganäs steel powder with **1 %** of Si_3N_4
- Höganäs steel powder with **0.333 %** of Si_3N_4
- Höganäs steel powder with **1 %** of SiC
- Höganäs steel powder with **0.333 %** of SiC
- Höganäs steel powder with **1 %** of Al_2O_3
- Höganäs steel powder with **0.333 %** of Al_2O_3

Attrition milling parameters for ODS composites

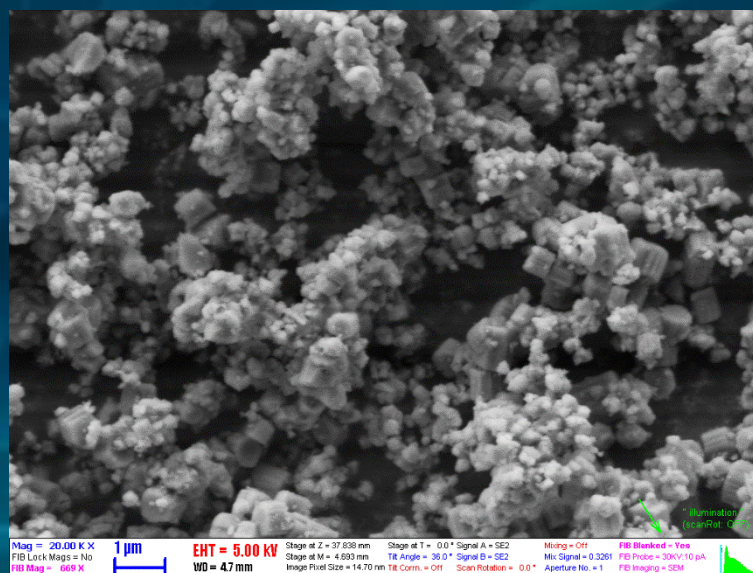
	Size of Steel jar	Steel Balls weight	Steel powder Wt (at 1 time)	percentage	Ethanol (ml)	Milling time	Mixing repetition
Y2O3	Small	1486	150	1%	150	5h	8
	Small	1486	150	0.333%	150	5h	8
Si3N4	Big	2972	300	1%	300	5h	4
	Big	2972	300	0.333%	300	5h	4
SiC	Big	2972	300	1%	300	5h	4
	Big	2972	300	0.333%	300	5h	4
Al2O3	Big	2972	300	1%	300	5h	4
	Big	2972	300	0.333%	300	5h	4



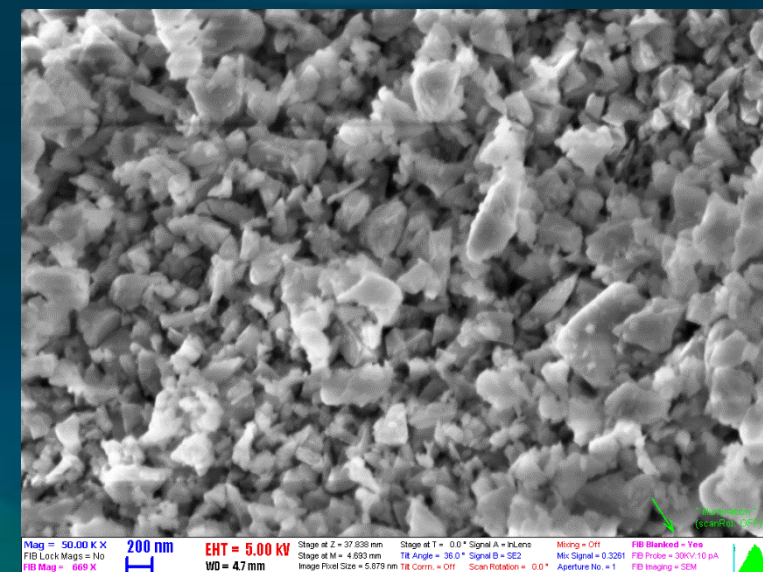
SEM Study of Y₂O₃, Si₃N₄ and SiC-UF



Y₂O₃



Si₃N₄



SiC-UF

Attrition milling

Milling speed (rpm)	Balls diameter (mm)	Milling time (h)	mode
600	3	5	HDDM1



SOUND INSULATING ROOM





Short summary about the semester

- Passing all the subjects successfully
- Participating in “ LA SIXIEME ECOLE SUR LES TECHNIQUES DE CARACTERISATION DES MATERIAUX “ at Mohamed Khider University of Biskra, Algeria by video conference.
- Participating in Webinar conference about « orgonizing research work and time »
- Visiting IMR SAS in Kosice
- Attending the Hungarian Microscopy Conference, Siofok, 2016. 05. 19-21
- Preparing 6 alloys
- 1 paper is ready to be published this August
- 2 papers are under process to be published

Plans for future work

- Publication of the papers under process
- Sintering of the milled powders by SPS
- structural investigation of novel sintered ODS based composites prepared by attritor milling and spark plasma sintering
- mechanical and tribological characterization

**Köszönöm a
Figyelmet**

**شكرا على حسن
الإصغاء و المتابعة**

THANK YOU FOR YOUR ATTENTION



Preparation of jars (cleaning)

