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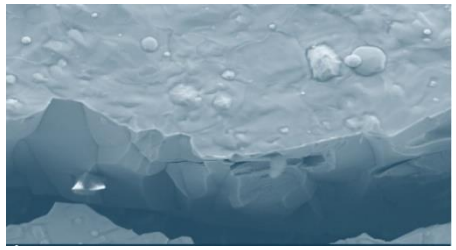
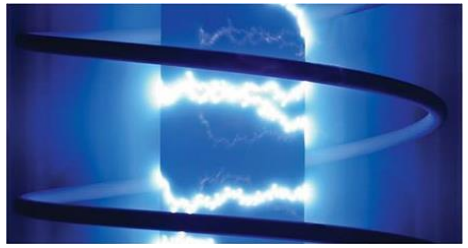


KRAFTONWEG OY

New ARC-plasma technologies to future

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About Us:

Years of experience in material science and PVD coatings technologies.

Our team has been working on development novel metal coatings, new metal materials and related new deposition technique for more than 5 years.

We combine research and experimental production.

We are focused on development of new vacuum plasma technology including new functional metal coatings and films, new methods of deposition and new coating materials.

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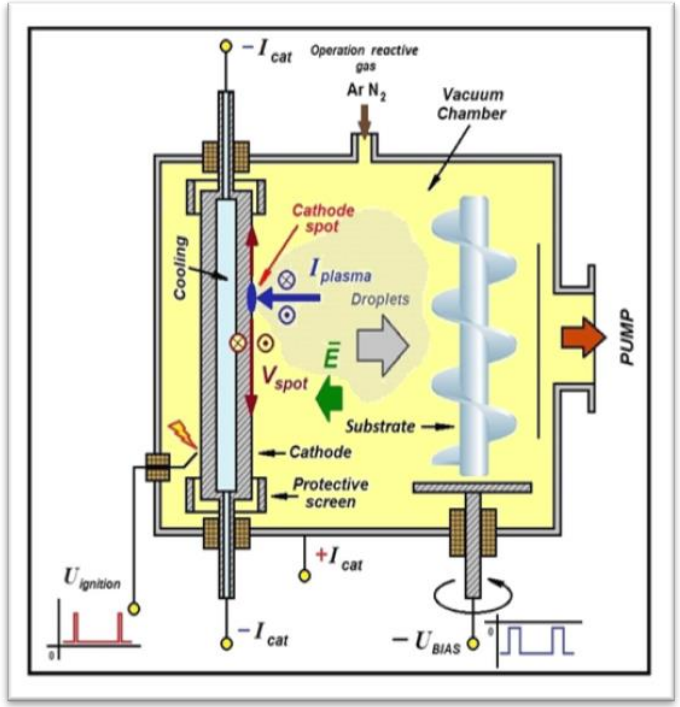
Basics of Technology:

Our novel **Droplets PVD** high vacuum technology utilizes the physical processes occurring in the flow of physical cold plasma.

The Technology resembles vacuum metallurgical processes, BUT:
We put the process within plasma flow.
We use all 3 components of a metal plasma: plasma, droplets and vapor.
This allowed to fast obtain new film materials (in 20-300 µm), absolutely homogeneous, with no columnar structure.
At the same time we can obtain complex and multi-layered materials.

This technology is developed in our company having no analogues and has never been used before.

Schematic Diagram of the Process



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Abilities of the Technology:

- Coatings/films in various metals, including refractory (Zr, Ta, Ti, Mo, etc) and their combinations. Coating material retains the mechanical properties of original metal and, in some cases surpasses them.
- Possibility to produce coated sheet and roll materials.
- Possibility to determine corrosive and abrasive properties of the material.
- Possibility to obtain Low Temperature Superconductive Nb, NbTi, NbGe films with very high values of the critical current density as well as very good mechanical properties for further machining. Niobium films retain the mechanical properties of the initial material. The technology enables to produce superconducting cables in a simple and inexpensive way.
- Obtaining film of NbGe should result in creating new superconducting material that can not be produced by conventional metallurgical ways.

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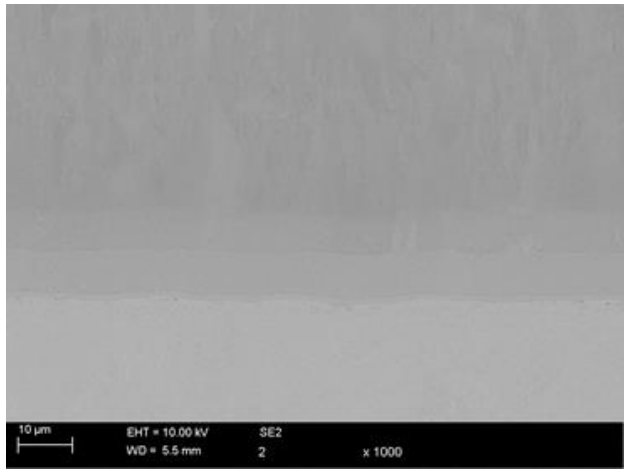
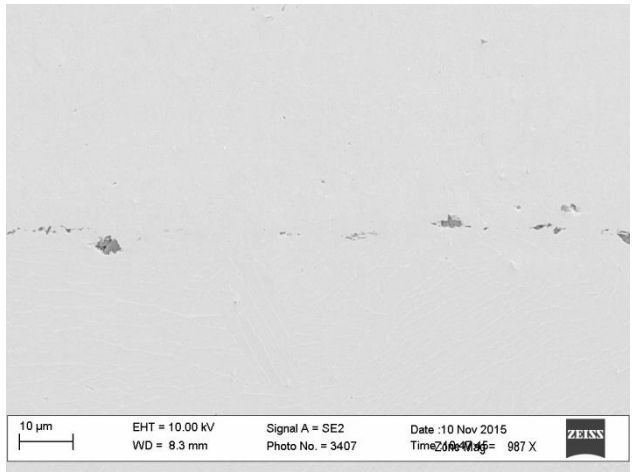
Just Few Results of Our R&D:

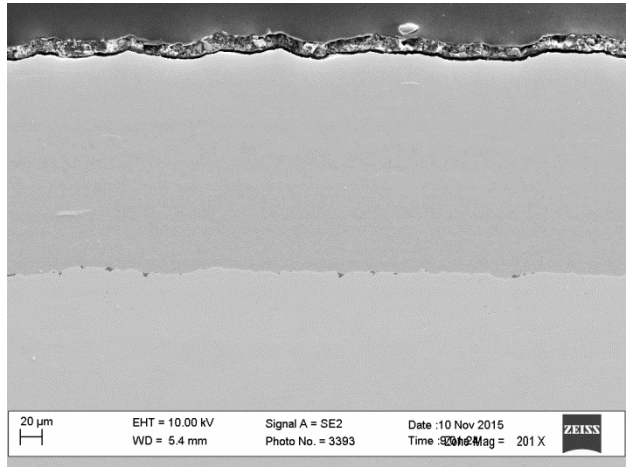
Cathodes



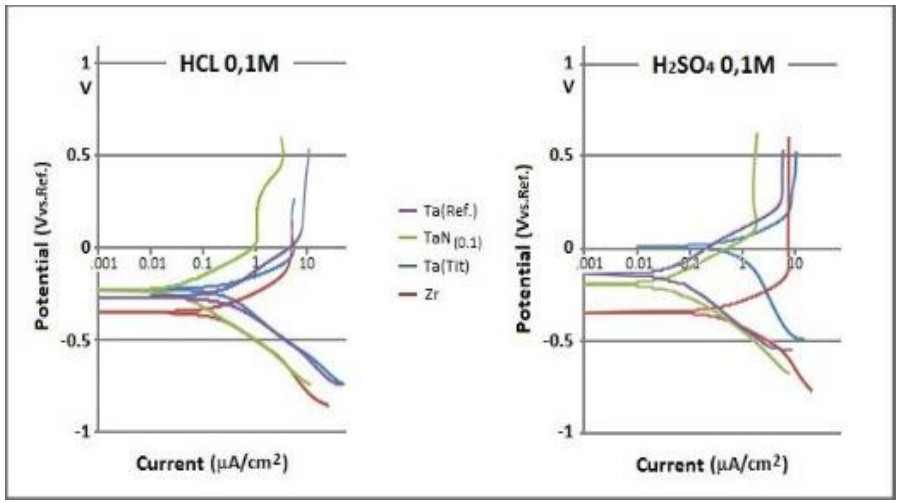
Ti on AISI 316



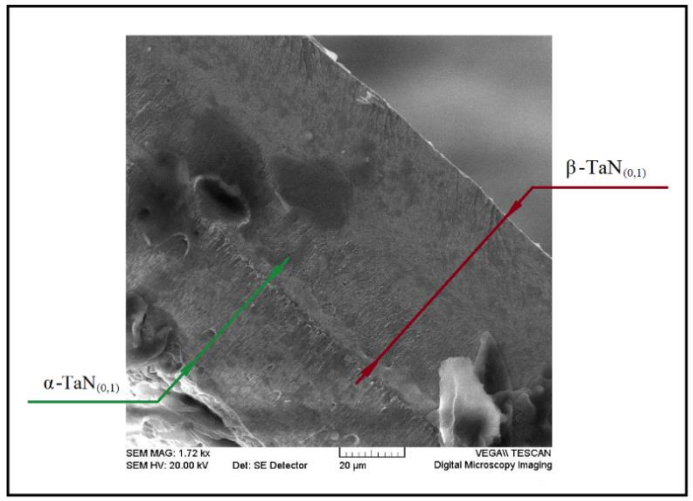
Ti-6Al-4V on Ti-6Al-4V



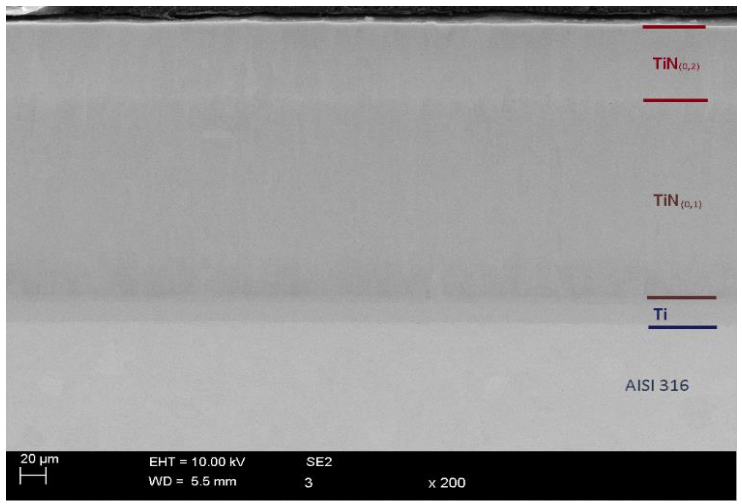
TiCu on AISI316



Corrosion resistance of our Droplets PVD coatings and CVD Ta to compare



α-TaN(0,1) plus β-TaN(0,1) coating



Layers of TiN(0/0,1/0,2) coating, structure and adhesion

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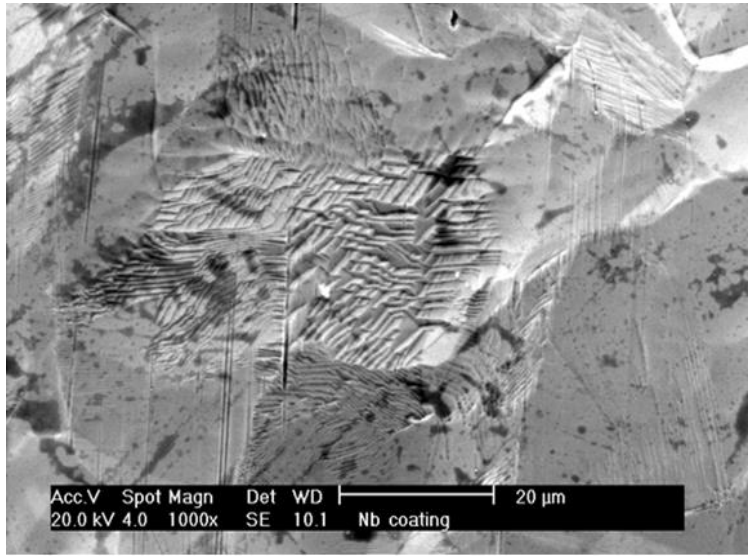
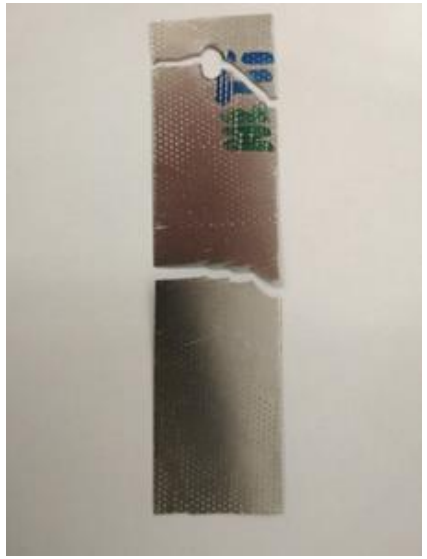
Research in Nb -based Coating Materials:



Surface of Nb coating (FSEM)



Mo plate with Nb coating after testing

Nb coating on 3 materials Al_2O_3, Cu and W wire.

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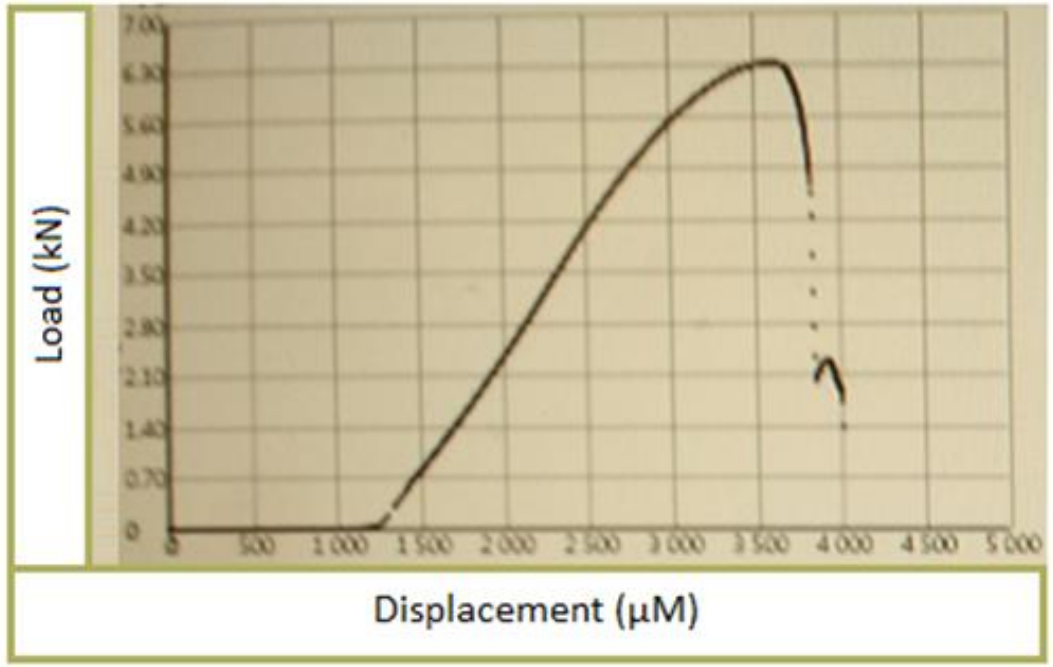
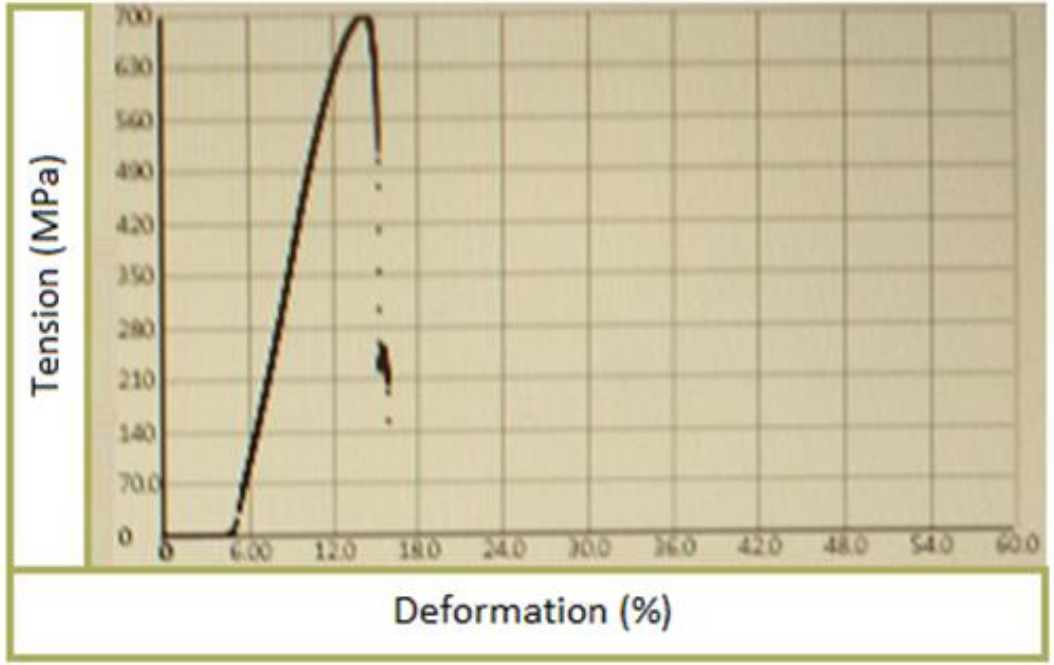
Tension Testing: Nb coating on Mo plate.





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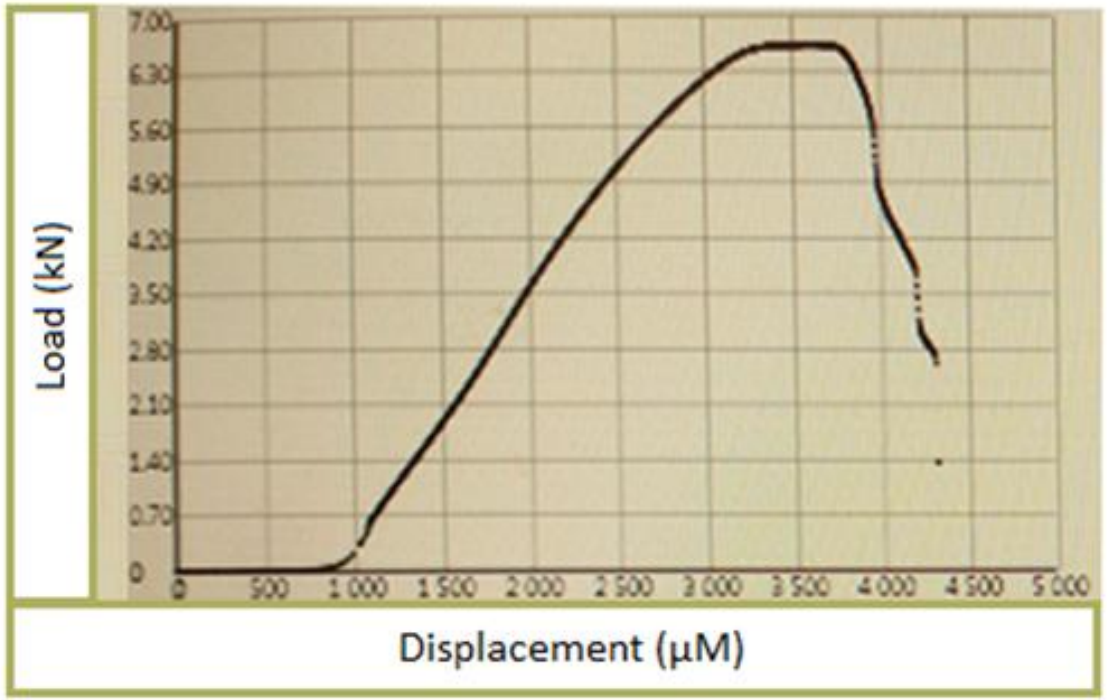
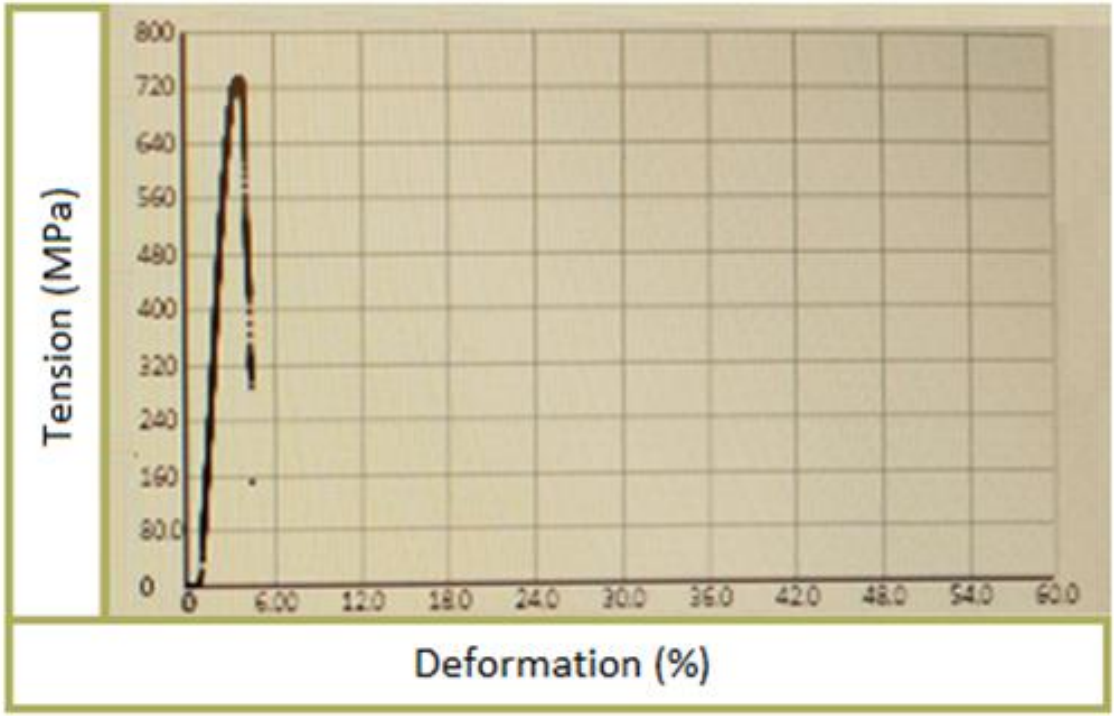
Tension Testing: NbTi coating on Mo plate.





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No. of sample	Thickness, mm	Width, mm	Cross-section area, mm ^{2}	Length, mm		Load, kN	Fracture strength, MPa	Relative extension, %	Relative necking, %
				initial	final				
1	2	3	4	5	6	7	8	9	10
1	0,31	24,2	7,5	92,9	92,9	6,59	879	-	-
2	0,31	25,5	7,91	112,3	112,3	7,91	905	-	-
3*	0,39	27,2	10,61	94,4	97,8	5,09	480	3,6	4,4
4**	0,35	20,9	7,32	94,2	94,7	6,32	863	0,5	-
5***	0,35	25,9	9,07	94,2	95,5	6,63	732	1,38	2

References:

(*) - Sample with Nb layer sprayed (on one side, about 80 microns)

(**) - Sample with Nb-Ti layer sprayed (on one side, about 40 microns) and with concentrator, hole of 5mm in diameter

(***) - Sample with Nb-Ti layer sprayed (on one side, about 80 microns), with repeated load after testing of sample no.4

- Consequences

1. Strength properties of Mo plate coated with Nb (one side coated in about 80 microns in thickness) differ from ones of original substrate. The Fracture Strength is 1.9 fold less than of the plate before coating, what reveals the influence of sprayed layer.

2. The properties of Mo plate coated with Nb-Ti are nearly the same as for original substrate (1.05-1.2 times difference) what means minor effect of relative coating.

3. The ductility appearing after Mo-sample coated with Nb and also for Mo-sample with Nb-Ti coating reveals the effect that the composite structure is formed at "substrate-coating" area.

- Conclusion

Increasing of coating thickness leads to rising influence on formation of "substrate-coating" composite structures. Variations in coating composition probably intensify that influence on "substrate-coating" composite structures formation, while the adhesion of coating to substrate remains the same.

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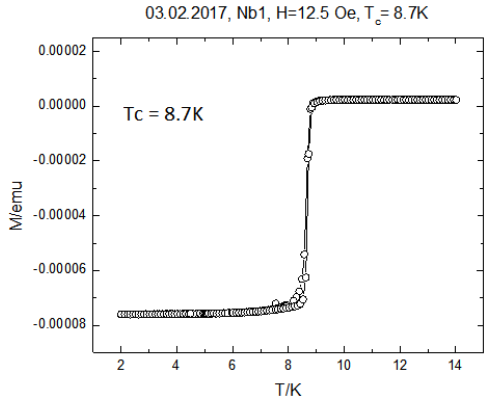
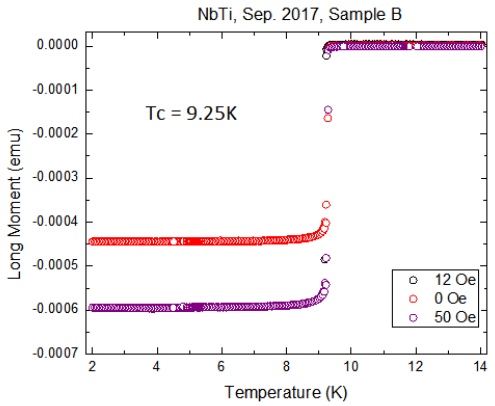
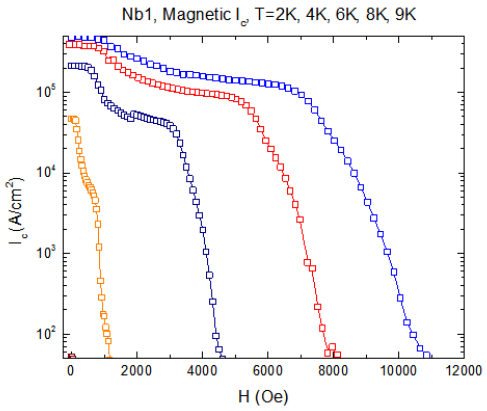
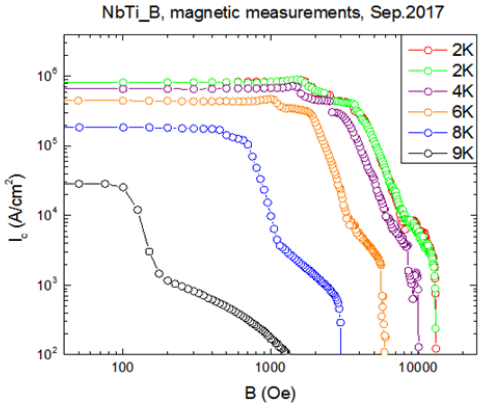
Thus, the Technology allows us to produce thick metal films and coatings with very specified properties:

- Corrosion / wear resistant coatings
- Metallic composite materials
- Easy-to-manufacture LT Superconductive materials









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Excellence and Opportunities:

- Coatings from 20 to 150 microns in thickness.
- Uniform fine-grain structure of coating material. Absence of column structure.
- Detached film material in 20-300 microns thickness.
- Low power consumption.
- High productivity - deposition rate of 1-5 microns per minute.
- Possibility to predetermine and control material structure of the coating / film.
- Complex cathodes with 2 and more metals enable production on intermetallic materials.
- Possibility to put thick film also on ceramic materials
- Easy to install our evaporator into existing vacuum equipment.
- Clean and environment friendly technology.

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Possible products:

- Coated sheet material.
- Metal films.
- Metal coating on lengthy, plane and other details.

To obtain these products the existing equipment is used with our newly designed source. Our facility is flexible enough, can be used to coat either sheet metals or lengthy/plane components at the same time.

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Possible applications:

The technology allows to produce thick metal films and coatings with customer-specified properties, being they corrosion, wear resistant or superconductive; such metallic composite materials can not be obtained by any other way.

The technology could be robotized in principle. Having installed the evaporator in the robot's arm one could coat complex surfaces of components with various metals including refractory ones.

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Technical Competition

	VACCUM TECHNOLOGIES				VACUUM/AIR	
	PVD , MAGNETRON	CVD	EXPLOSION WIELDING	PVD droplets	THERMAL / LASER	ELECTROPLATING
Corrosion resistance	poor	good	excellent	excellent	medium	good
Adhesion	good	medium	medium	good	medium	poor
Flexibility (multi-layer, alloying, doping, metals variety, etc.)	good	poor	none	excellent	medium	poor
Structuring	poor	medium	none	good	medium	poor
Thickness if the coating, µm	0,5-5	10 - 40	over 1000	5-150	1- 500	10 - 3000
Temperature of substrate	low	high	medium	high	medium	low
3-dimensional coating	medium	excellent	none	poor	good	medium
Maximum size/width to coat,	600-1000 mm	500 x 500 mm	Large	300-1000 mm	large enough	large

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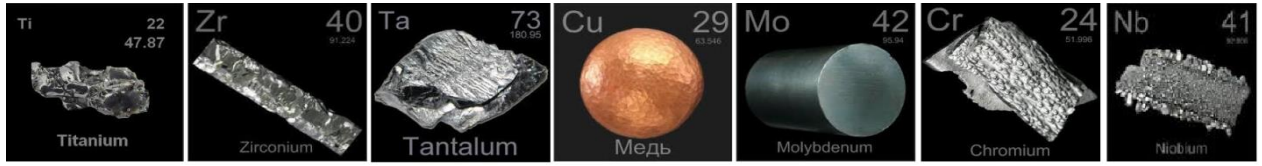
ADDED VALUE though FLEXIBILITY



UTMOST EFFECTIVE SOLUTION FOR EACH CUSTOMER

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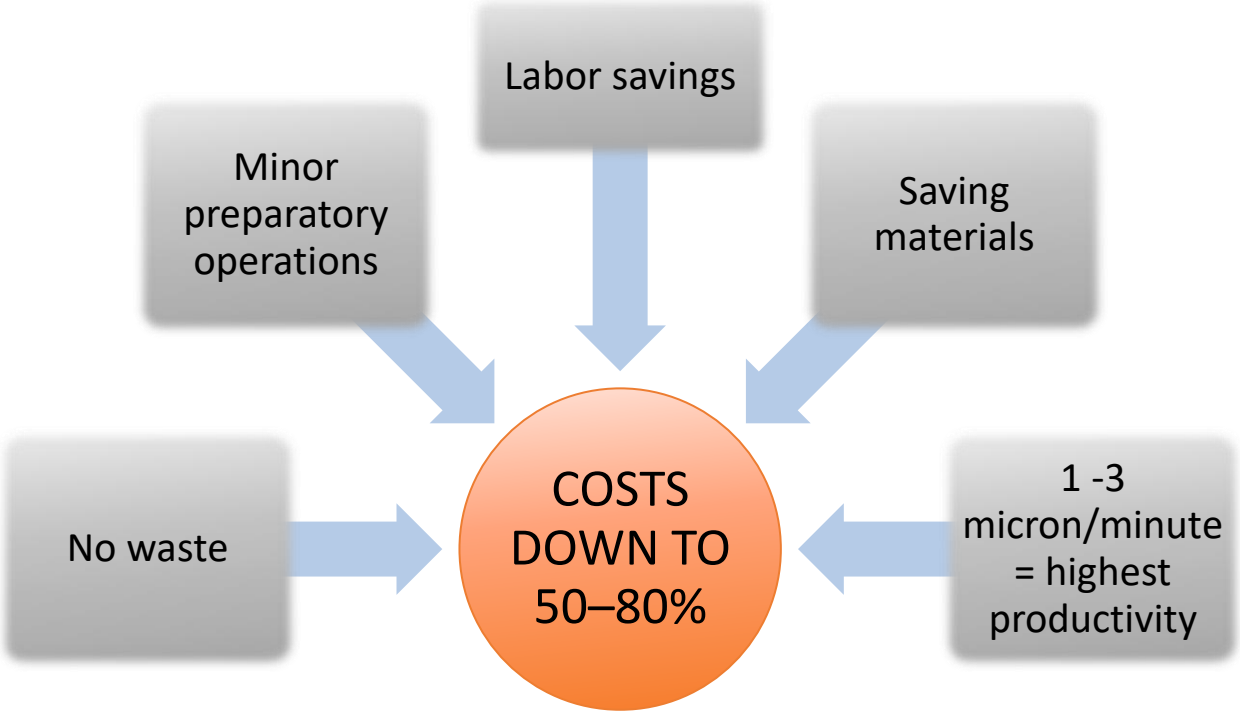
ADDED VALUE though COSTS REDUCTION



Limitations:

- Melting point of the substrate must be above 600 Celsius degrees. Otherwise additional cooling of the substrate required during the process.

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Current Partners:

- Tampere University of Technology, Finland, Department of Materials Science
- Aalto University, Low Temperature Laboratory, Department of Applied Physics, Finland
- Welcome

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