

**ABSTRACT**

Environment pollution produced by metal traces is a highly concerned issue. One of the important causes of trace metal pollution is particles discharging out of industrial processes which normally exist in micro/ nano size particles.

These metal traces pose life-threatening effects on human kind health and safety. The aim of this dissertation is to determine cobalt (Co) and Nickel (Ni) existence which are produced from cermets, consist of boron carbide and Ni 625 alloys, used in tribology applications to evaluate Co and Ni toxicities in these samples.

Cermets contain Boron Carbide and Nickel alloys compounds are used as case study in this dissertation due to their promising industrial applications.

Implantation and preparation of cobalt alloys has been prepared by plasma powder transferred arc welding.

Having boron carbide and nickel alloys have major problem, that none of the previous investigations give sufficient evidence of a carcinogenic effect in humans.

Additionally, the classification provided by companies to ECHA in REACH registrations identifies that this substance has high risk impact. Therefore, risk assessment and diagnostic aid in assessing the health of operating plant, which may contain many tribological contacts, requires not only appreciation of the mechanisms, by which wear occurs, but also careful and standardized procedures for debris extraction and observation either by solving these particles in liquids or using cleaning oils to prevent having hazard materials in free movement atmosphere.

**OBJECTIVES**

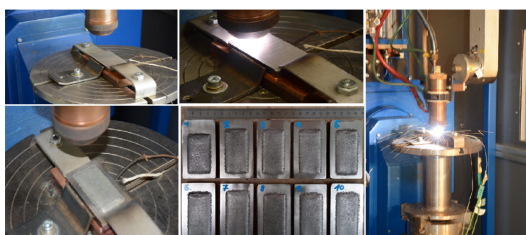
Target here is to proof possible risk of using cermets (B4C + Ni 625 alloys) in tribological applications by finding, during tribological experiments, that cobalt and Nickel particles produced and this can be dangerous for health of people working in this field.

Study Objectives:

1. Existence of cobalt and Nickel micro & Nano particles resulted from tribology.
2. Heat treatment effect on cermets physical characteristics and how it will change tribology efficiency.
3. Micro & Nano sized cobalt and Nickel particles existence in free movement.
4. Conclude the effectiveness of the approach as a means of showing risk of this material usage and possible impurities during manufacturing processes.

**EXPERIMENTS/ RESULTS**

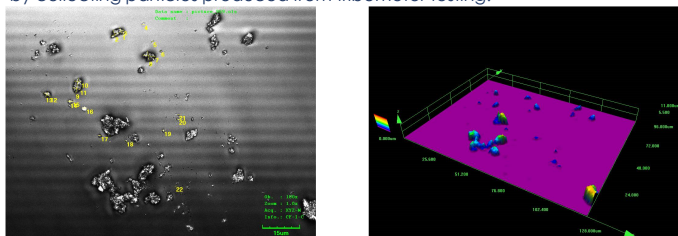
Cermets were deposited by plasma transferred arc (PPTAW) using the Nickel based super alloy Inconel 625 and Boron Carbide, manually controlled procedure, with a commercially available plasma hard-facing automate PPC 250 R6 (KSK, s.r.o., Czech Republic) in a light chamber.



Parameters	Peak current I <sub>p</sub> (A)	Background current I <sub>b</sub> (A)	Pulse frequency f (Hz)	Duty cycle (%)	Welding speed (m/min)	Powder Filler material (g/min)	Oscillation
Value	100	45	28.7	-	0.4	1.5	28mm by 28 mm/s

Tribometer test performed into these parameters: Applied load on disk: 29,4[N]/ Stroke (Step): 2\*35 [mm]

Confocal laser scanning microscopy (CLSM) is used as characterization tool to determine size of different micro/ nano particles. Micro-particles were prepared by collecting particles produced from tribometer testing.

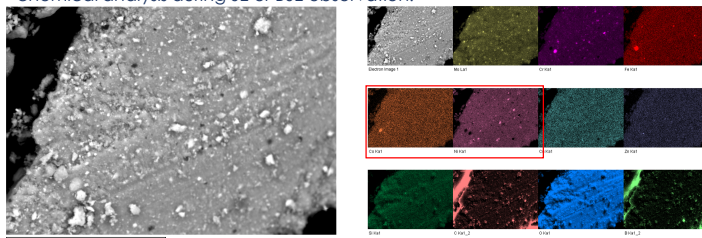


Result	Length[um]	Z[um]
18	0.5095	0.066
19	0.7747	0.087
20	0.8053	-0.089
21	0.6494	0.038

Electro Microscope Particles' analyze after test:

Scanning Electron Microscope is used for materials characterization, imaging and chemical analyzing, to determine potential risks of nanomaterials to human health.

- Secondary electron (SE) imaging is used to have straightforward analysis of surface morphology.
- Back-scattered electron (BSE) is used to provide a characterize of chemical compositions in a sample.
- Energy dispersive X-ray (EDX) spectroscopic analyses allows simultaneous chemical analysis during SE or BSE observation.



**CONCLUSIONS**

- Confocal microscope and electron microscope were used to identify and recognize size of produced particles. Nano sized particles and micro sized particles have been observed clearly.
- Micro & Nano sized Cobalt particles were noticed in particles produced by tribology test (variant heat treated disk vs heat treated tablet) more than variant (heat treated disk vs non heat treated tablet).
- Micro & Nano sized Nickel particles were noticed in particles produced by tribology test (variant heat treated disk vs heat treated tablet) more than variant (heat treated disk vs non heat treated tablet).
- Higher care is needed here for handling discharged particles from this studied material.
- It is important to destroy these harmful particles as preventive action by solving it into liquid or by another possible after treatment methods (Burning, Liquidation, Chemical reaction, ...), which could be part of case study future work.

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