

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ



Materials and Energy  
Research Center

# Plasma electrolytic oxidation coatings on Al alloy for improved properties

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## Main titles

- Introduction to PEO
- Applications of PEO Coatings
- Structures of PEO coatings
- Properties of PEO Coatings
- Our work
- Conclusion

# Introduction

## What is PEO ?

- PEO is a relatively novel surface modification technique
- Creates ceramic coatings on the surface of Al, Mg, Ti & their alloys
- Also called Micro arc oxidation, Micro plasma oxidation, Anodic spark deposition

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to PEO

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Structure of  
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## What is PEO ?

- PEO is similar to conventional anodizing
- In contrast to anodizing, PEO applied in high voltage, typically 400-800 V
- Applying high potentials results in the formation of plasma micro-discharge events
- Appear as numerous sparks on the surface of the sample

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## Advantages of PEO process

- pre-treatment processes are minimal
- the process is eco-friendly due to its use of mostly alkaline aqueous non-toxic solutions
- less toxic fumes are produced during the treatment
- Harder coatings with excellent adhesion can be achieved

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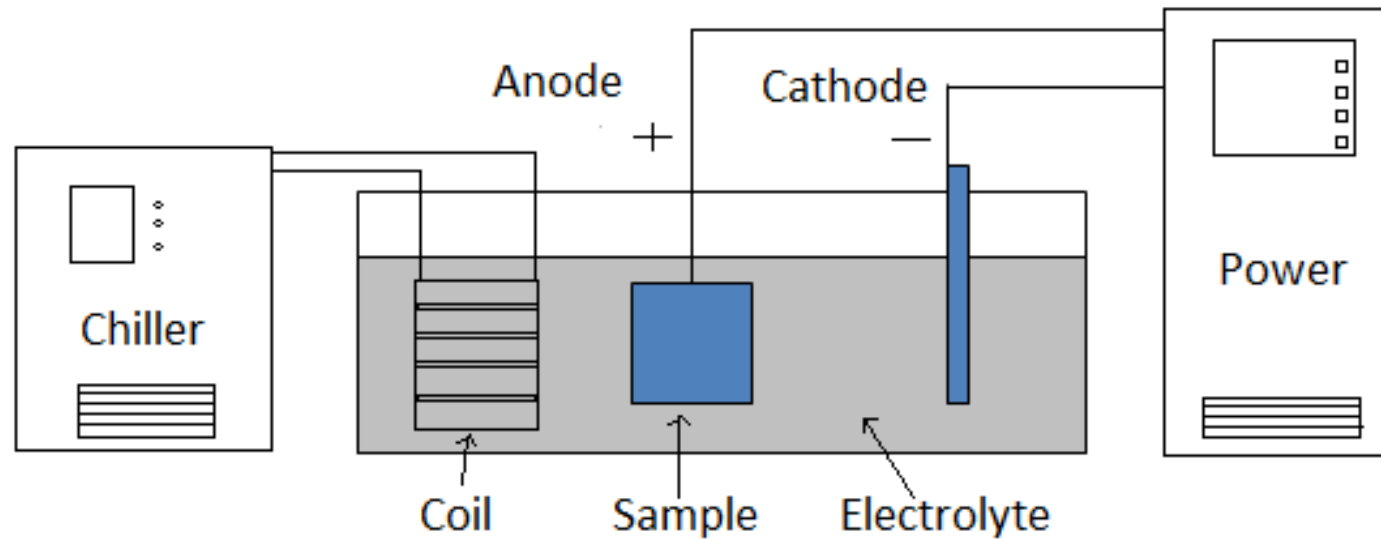
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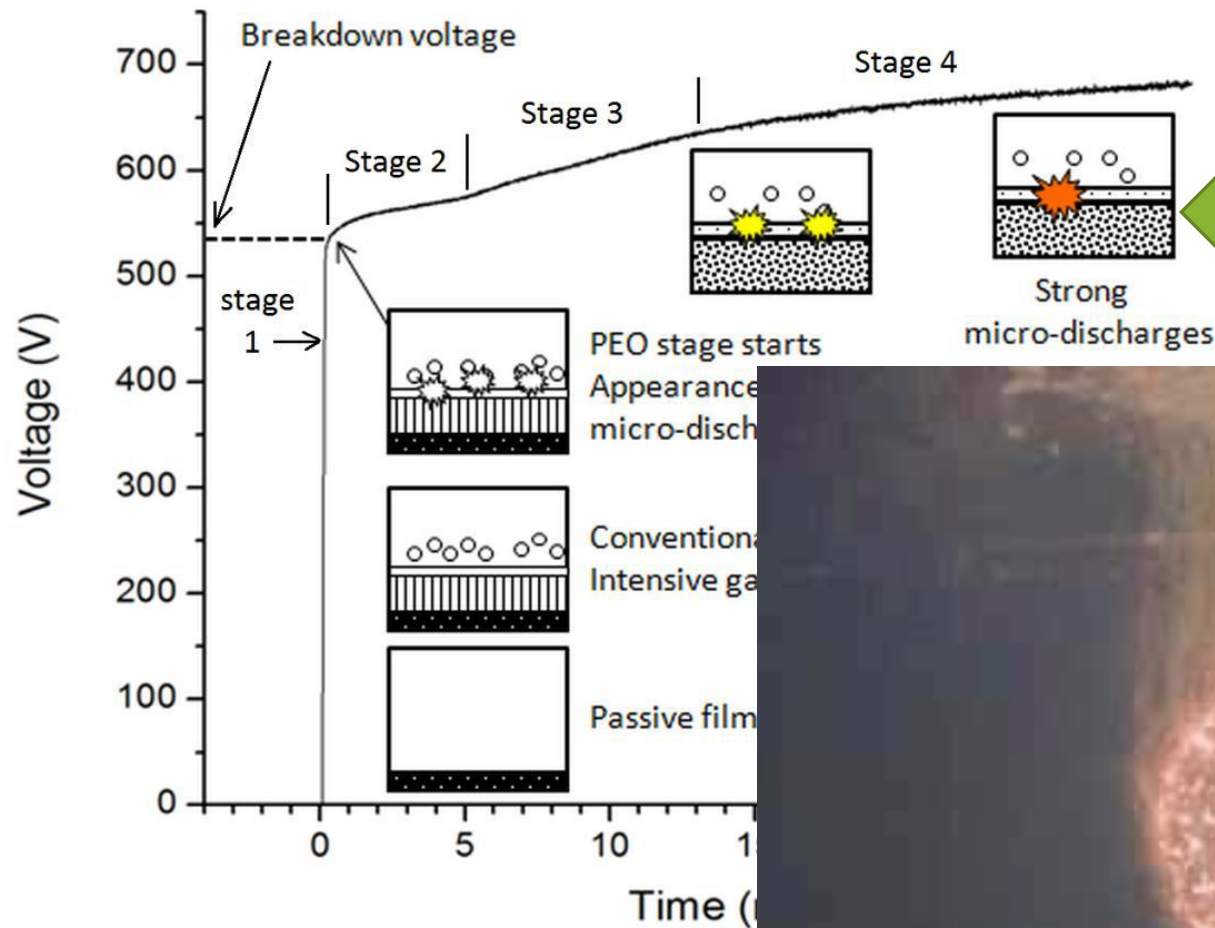
# PEO Equipment Setup



Schematic view of the PEO process.

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# Plasma electrolytic oxidation coatings on Al alloy for improved properties – S.Rahimi



Schematic of the different phenomena occurring

James Curran 2003

Ref. Dehnavi, Vahid. *Surface Modification of Aluminum Alloys by Plasma Electrolytic Oxidation*. Diss. The University of Western Ontario, 2014.

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# Development of PEO Processing

<b>1880s</b>	electrolytic discharge phenomena was discovered
<b>1930s</b>	electrolytic discharge phenomena was studied in detail
<b>1960s</b>	cadmium niobate was deposited onto a cadmium anode in a Nb-based electrolyte
<b>1980s</b>	Oxide layer on an Aluminum anode was deposited and studied
<b>1990s</b>	Industrial applications were introduced and methods were patented
<b>2000s</b>	Process parameters were studied and more industrial applications were discovered

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# Applications of PEO Coatings

- Automotive
- Aerospace
- Construction
- Electrical
- Biomedical
- Oil and gas processing
- Sports

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## Active companies in PEO field

- Keronite (UK)
- Magoxide-coat (Germany)
- Microplasmic (USA)
- IBC Coatings Technologies



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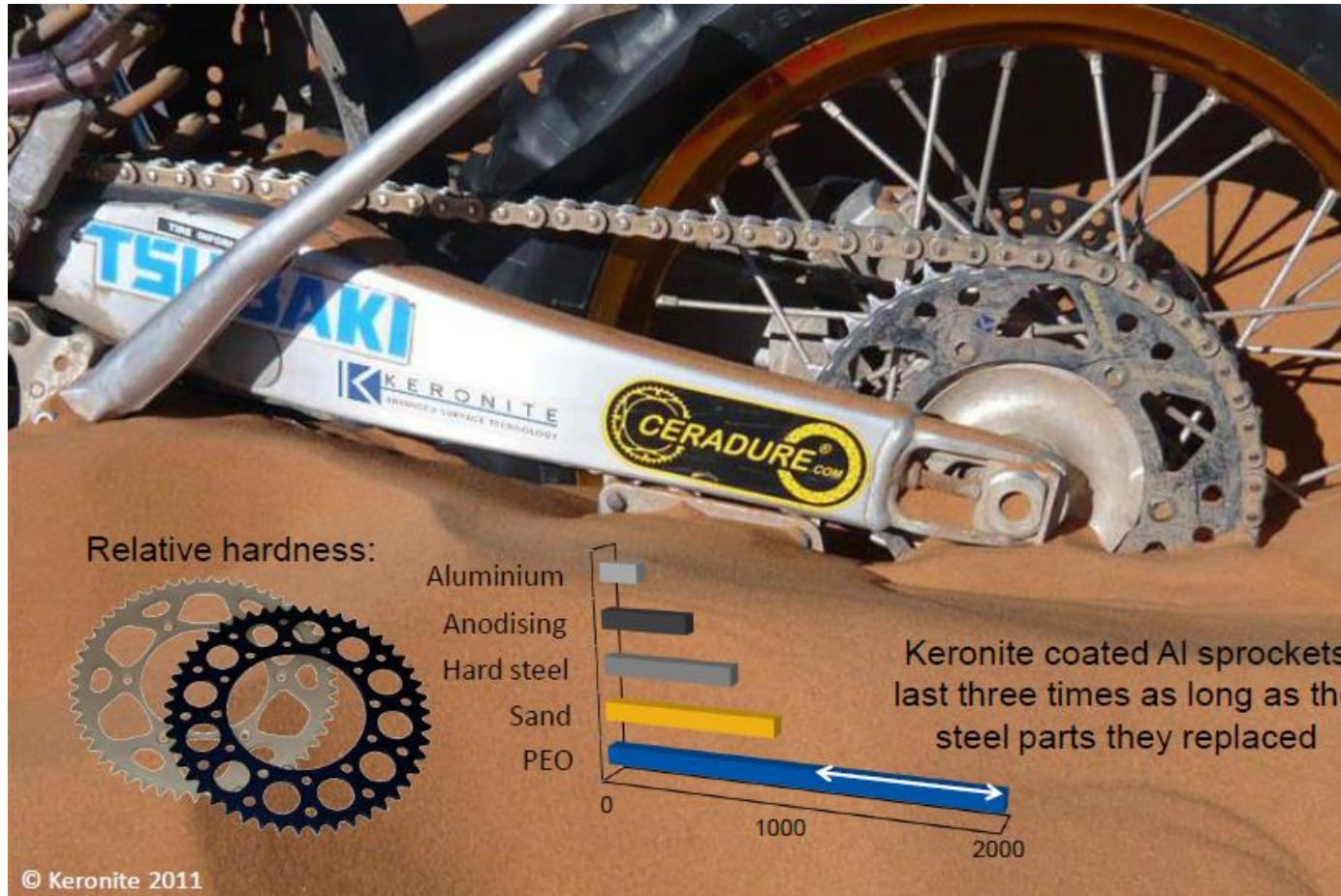
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# Al sprockets



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# Winch drums

The America's Cup Yacht *BMW Oracle* pioneered the use of Keronite™ coated winch drums in 2007. These have since been widely adopted in high-performance racing yachts.



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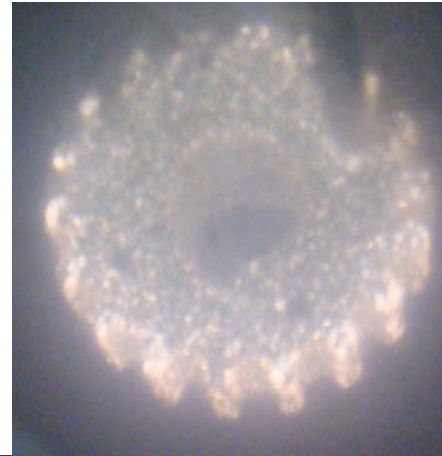
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# Gear



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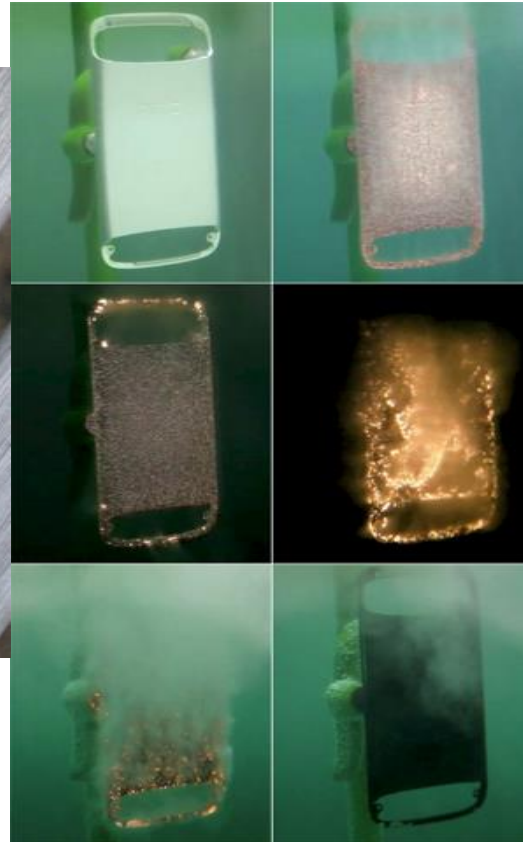
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# HTC phone



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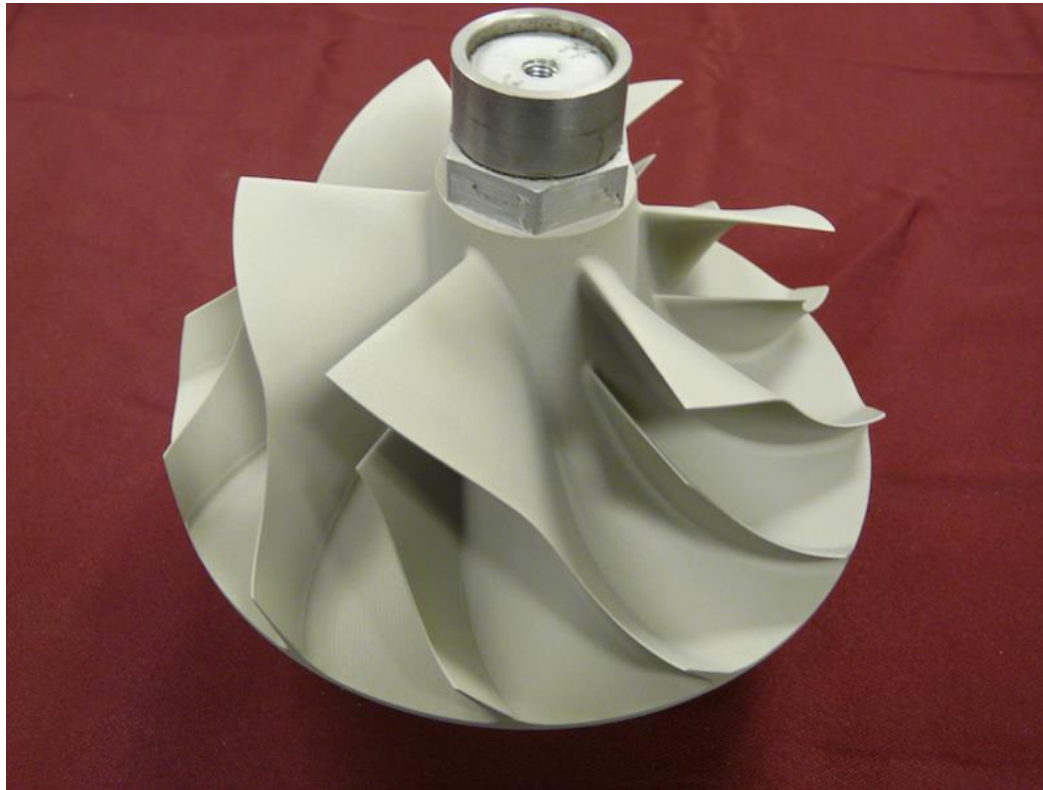
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## 3-D running wheel



*3-D running wheel made of AlZnMgCu<sub>0.5</sub>, with 50 μm KEPLA-COAT<sup>®</sup> layer for expansion turbines and turbo compressors*

Ref. [www.ibccoatings.com](http://www.ibccoatings.com)

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# Flashligh (sports equipment)



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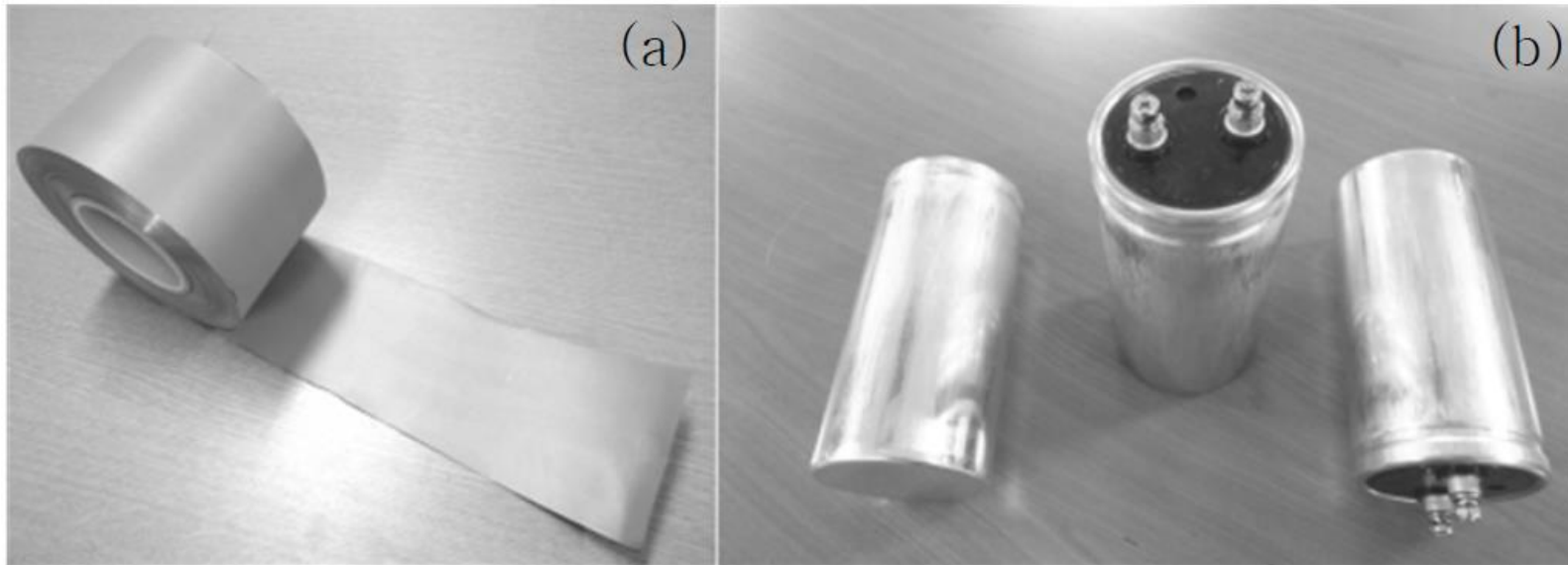
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# Coated rolls



(a) Aluminium roll coated by PEO process  
(b) capacitors produced by coated rolls

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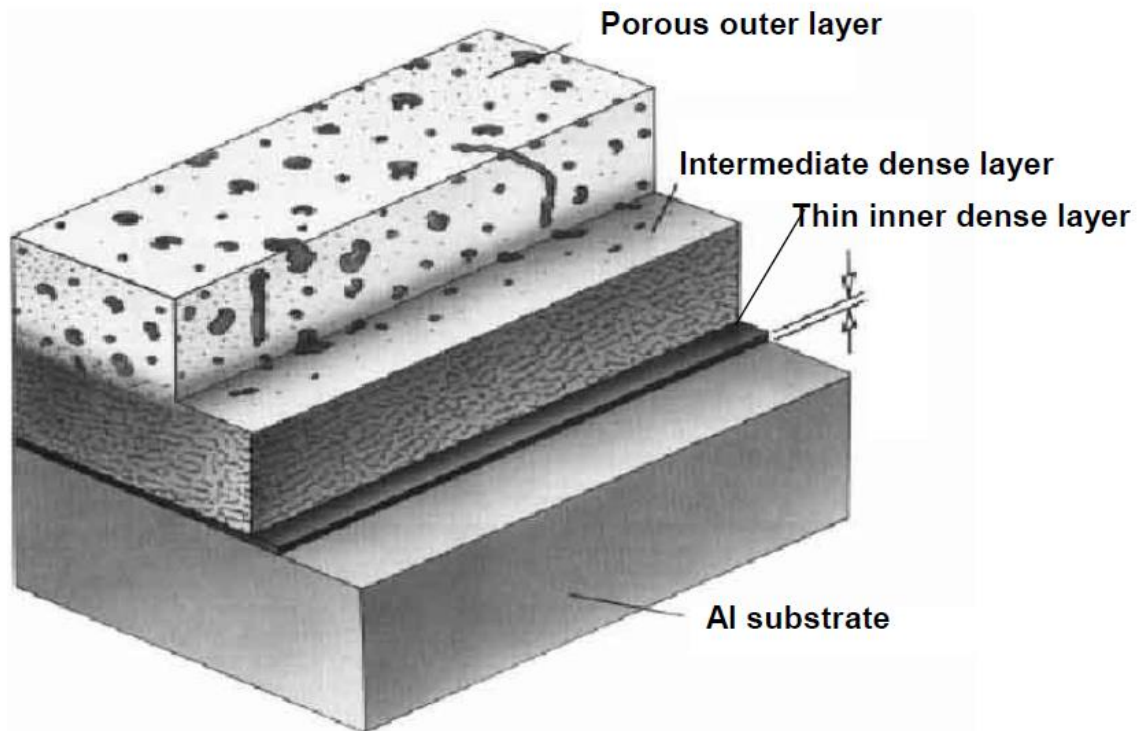
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# Structures of PEO coatings



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# Properties of PEO coatings

- Mechanical Properties
- Wear Resistance Properties
- Corrosion Resistance Properties
- Thermal Protection Properties
- Dielectric Properties

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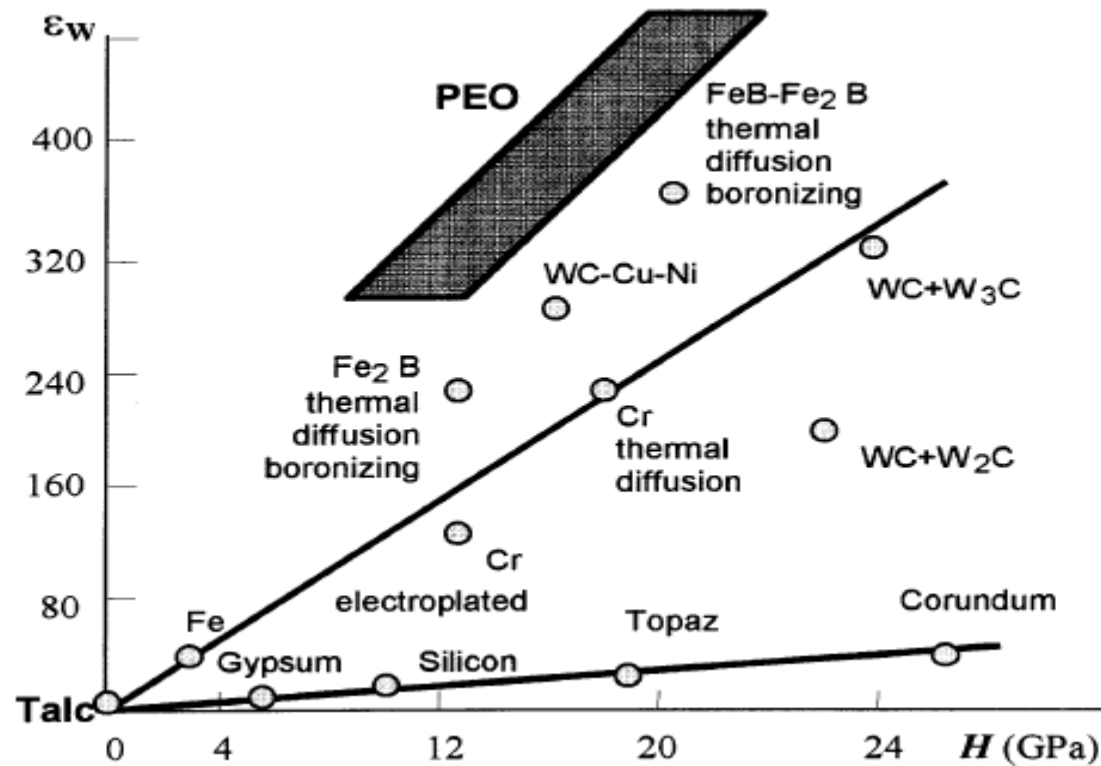
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# Properties of PEO coatings



Relative wear resistance ( $\epsilon_w$ ) of various materials with different hardness ( $H$ ) values with respect to talc

Ref. A.L. Yerokhin, X. Nie, A. Leyland, A. Matthews, S.J. Dowey, Plasma electrolysis for surface engineering, Surf. Coatings Technol. 122 (1999) 73–93.

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## Our work

- Preparation of PEO coating on Al-Si alloy
- Finding an optimum condition of process parameters to achieve a coating with best wear and corrosion resistance
- Coated Al-Si alloy can utilize in industrial part

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## Conclusion

- PEO is a suitable method to produce hard, dense and thick coatings on light metals because of its particular properties
- PEO is a flexible coating and has been utilized in various industries
- We can improve the Al-Si alloys properties by PEO and utilizing them in industries

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# Thanks for your attention

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