

Engrena ITA

Reunião de Trabalho RT21.1

Smart Materials

Angelo Carvalho, M.Sc.

April 14th, 2021



Engrena ITA studies: *Smart Materials*

- “Smart Materials” was the **most voted topic of Engrena ITA RT19.1**
 - The topic was presented by Poli-USP

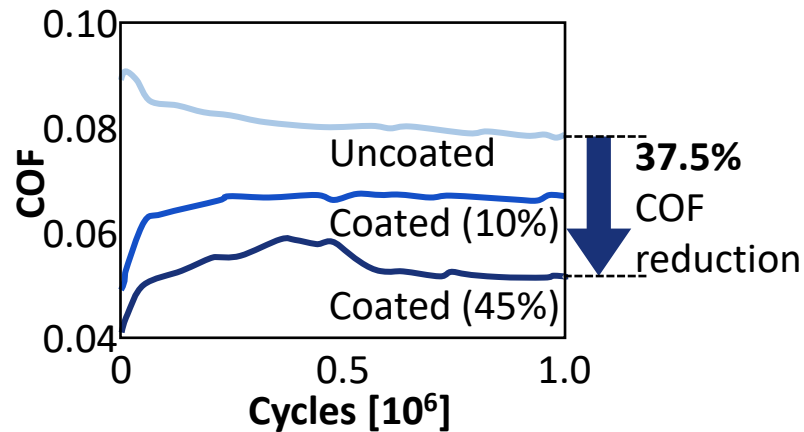


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Laboratório de
Fenômenos de
Superfície

Ti:MoS₂ coating - Preliminary studies

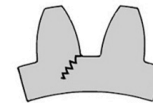
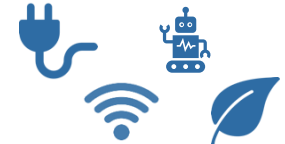


Innovation opportunity

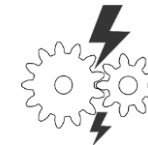
- Replacing titanium with niobium: **Nb:MoS₂**
 - **Technological and economical advantage** for Brazilian Industry

E-mobility trends

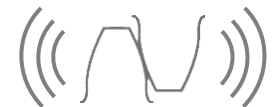
- Fewer gears/vehicle
- Higher engine rotation
- Higher mileage/vehicle
- Silent engines



Higher fatigue
resistance



Higher
efficiency



Less NVH
emission

Innovative solutions such as **coated gears**

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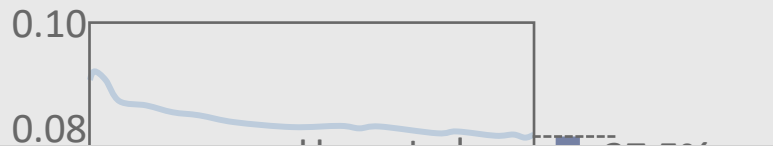


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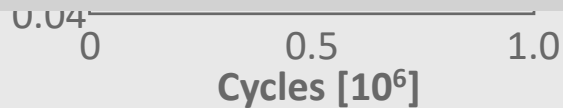


E-mobility trends

- Fewer gears/vehicle
- Higher engine rotation



Assessment of the benefits of the **Ti:MoS₂**-based and the **innovative Nb:MoS₂**-based coatings on **gear efficiency** and **fatigue** strength



Innovation opportunity

- Replacing titanium with niobium:
Nb:MoS₂
 - **Technological and economical advantage** for Brazilian Industry



Higher fatigue
resistance



Higher
efficiency



Less NVH
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Innovative solutions such as **coated gears**

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WP1 Evaluation in simplified samples

Raw material selection

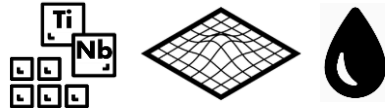


Lab-scale testing

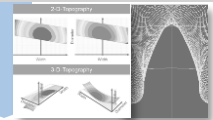
Coating formulation

Substrate topography

Lubrication influence



Design of gear samples



WP2 Manufacturing of gear samples

Manufacturing of gear samples



Ti:MoS₂ and Nb:MoS₂ coating



Finishing after PVD

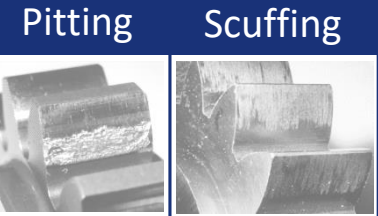


Quality control & mat. characterization

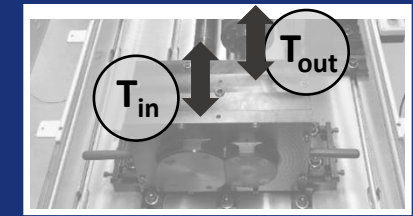


WP3 Dynamic behavior assessment

Dynamic gear testing



Gear efficiency



Dynamic gear testing



**ITA-USP
+6 Companies**

Engrena ITA studies: *Smart Materials*

WP1

Evaluation in simplified samples

Raw material selection



Lab-scale testing

Coating formulation

WP2

Manufacturing of gear samples

Manufacturing of gear samples



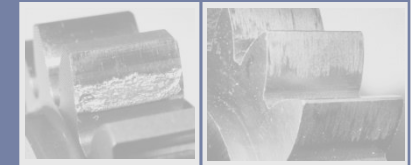
Ti:MoS₂ and Nb:MoS₂ coating

WP3

Dynamic behavior assessment

Dynamic gear testing

Pitting Scuffing



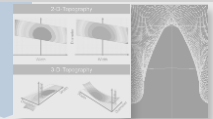
Gear efficiency



Funding opportunity: *FINEP "Materiais Avançados e Minerais Estratégicos"*



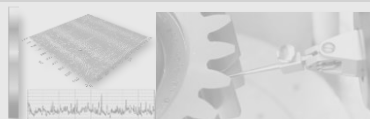
Design of gear samples



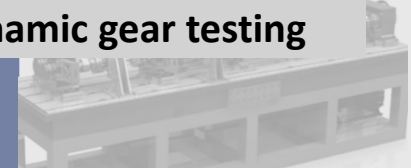
Finishing after PVD



Quality control & mat. characterization



Dynamic gear testing



**ITA-USP
+6 Companies**

Thank you!



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