Fundada em 15 de Maio de 1981
SOCIEDADE PORTUGUESA DE MATERIAIS
Pessoa Colectiva de Utilidade Pública
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FICHA DE PERITO

1- Identificação

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Qualificações Académicas	Doutorado
Filiação	Uiversidade de Coimbra
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Cargo ou situação profissional	Post-Doc
Experiência científica	Revestimentos para alta temperatura, comportamento mecânico de materiais, comportamento da resistência ao desgaste de materiais,
Experiência tecnológica	Desenvolvimento de revestimentos para moldes, ferramentas de estampagem e ferramentas de corte. Desenvolvimento de sensores para moldes.
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2- Áreas operacionais e tipos de materiais *(marcar com x)*

Matérias Primas		Materiais Metálicos	x
Processamento / Fabricação		Materiais Poliméricos	
Caracterização		Materiais Cerâmicos e Vidro	x
Aplicações		Materiais Compósitos	
		Materiais Naturais	
		Revestimentos	

3- Palavras-chave

Áreas operacionais *(5 palavras chave por cada entrada assinalada no quadro 2)*

Revestimentos	
Comportamento a alta temperatura	
Pulverização catódica	
Comportamento mecânico	
Comportamento tribológico	

Tipos de materiais *(5 palavras chave por cada entrada assinalada no quadro 2)*

Revestimentos	
Materiais metálicos	
Materiais cerâmicos	

Data: _01_/__07/_2019__ Filipe Daniel Fernandes Assinatura

Anexo (facultativo): publicações relevantes

The works selected **as most relevant to the advancement of knowledge in the area of Mechanical Engineering and Materials science** are the following **5 publications in prestigious international journals.**

[1] **F. Fernandes, T. Polcar, A. Loureiro, A. Cavaleiro, Effect of arc current on microstructure and wear characteristics of a Ni-based coating deposited by PTA on gray cast iron, Surface and Coatings Technology., 205 (2011) 4094-4106.**

[2] **F. Fernandes, A. Cavaleiro, A. Loureiro, Oxidation behavior of Ni-based coatings deposited by PTA on gray cast iron, Surface and Coatings Technology., 207 (2012) 196-203.**

[3] **F. Fernandes, T. Polcar, A. Loureiro, A. Cavaleiro, Effect of the substrate dilution on the room and high temperature tribological behaviour of Ni-based coatings deposited by PTA on grey cast iron, Surf. Coat. Technol., 281 (2015) 11-19.**

In those 3 research works the applicant played with the main deposition parameters of the Palsma Tranferred Arc process to produce weld beads without defects. The objective was to verify how the PTA deposition parameters influences the dilution of substrate and consequently the dissimilar properties of the material produced. Cast irons are commonly used in the production of glass moulds and accessories for glass industry, owing to their excellent thermal conductivity and relatively low cost. Moulds are often exposed to severe conditions of abrasion, oxidation, wear and fatigue at high temperature, due to repeated contact with melted glass, causing deformation or failure of parts and, thus, compromising the product quality and increasing the maintenance costs. To overcome this shortcoming, protective materials are normally applied in some zones of mould surfaces with the aim of increasing their lifetime in harsh environments. One of these materials are Ni-based alloys which are applied by plasma transferred arc. The properties and the quality of deposits are strongly dependent on the dilution of the substrate promoted by the PTA process. Low dilution provides coatings with similar chemical composition to the added metal powder, condition for achieving enhanced mechanical properties, wear and oxidation resistance. To avoid adhesion problems and, therefore, not to compromise the performance of moulds in service, it is common to increase the dilution through the change of the most relevant deposition parameters even if the mechanical properties, wear and oxidation resistance are diminished. We could show that increase of dilution

decreases the mechanical properties of films as well as their oxidation resistance. However, it showed to improve the adhesion and tribological properties at high temperature. Thus a compromise between these properties should be established to obtain the better properties. With this study we could propose alterations to the project of molds which allowed increase their service life in 20%.

[4] **M. Danek, F. Fernandes, A. Cavaleiro, T. Polcar, Influence of Cr additions on the structure and oxidation resistance of multilayered TiAlCrN films, Surf. Coat. Technol., 313 (2017) 158-167.**

[5] **F. Fernandes, M. Danek, T. Polcar, A. Cavaleiro, Tribological and cutting performance of TiAlCrN films with different Cr contents deposited with multilayered structure, Tribology International, 119 (2018) 345-353.**

Dry machining cutting conditions generate severe shear stresses and high temperature harsh conditions on the cutting zone which, consequently, lead to a premature degradation of the tool. Thus, a promising protective material which could protect the tool should exhibit simultaneously high toughness, low friction coefficient, low wear rate and thermal stability at high temperature conditions. In this work we proposed to develop new thin solid films of the TiAlCrN system deposited by sputtering technology, as multi-layered arquitecture and with increasing Cr additions. The increasing of Cr additions was achieved by playing with the main deposition parameters of the sputtering machine. Multilayer arrangement is well known to promote crack deflection, i.e, if the cracks initiates on the top surface multilayer structure will deflect this crack avoiding the failure of the protective layer and thus alloying extend the lifetime of the tool. On the other, Cr is well known to improve the oxidation resistance of materials as it forms a protective layer of Cr2O3 on the top surface. Comparison of the developed materials with one actually applied on the protection of the drills surface was also evaluated. The machining performance of the coated drills were conducted in a CNC machine by playing with different cutting velocities. The results showed the higher the Cr content in the films, the better the tribological performance, due to the higher amount of Cr-O in the wear track. Drilling performance of reference material conducted at low cutting speed (50 m/min) was 2 times better than Cr-rich coating due to its higher hardness, which is the dominant factor in the absence of sufficient oxidation and tribofilm formation. At higher cutting speeds, the drilling performance of reference material suddenly dropped due to the combined effect of the change of chip type (discontinuous to continuous) and the higher cutting severity. The latter led to an increase in the overall temperature of the cutting zone. Cr containing coating displayed significantly better cutting performance at higher cutting speeds due to the formation of a protective Cr-O rich tribolayer in the

cutting zone. In fact, the total number of holes before tool failure was in case of Cr rich coating increased with cutting speed, which makes these coatings good candidates for high speed dry drilling operations. Cr additions showed to improve the oxidation as well as the mechanical properties of the reference material. With this work the applicant was able to propose a new materials which improve the lifetime of drills for cutting operations executed at high cutting speeds and without the use of liquid lubrication. This solution was adopted by ADVAMAT Enterprise (in Prague) to protect the surface of tools. In addition, this coating material was applied on the surface of molds for the glass industry which allowed the extension of the use of liquid harmful lubrication and consequently the decrease the cycles of production of glass containers.