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#### CONTACTS

##### Secretariate

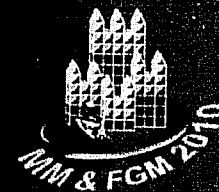
Sandra Lopes  
e-mail: [sandral@dem.uminho.pt](mailto:sandral@dem.uminho.pt)  
fax: +351 253 516007  
phone: +351 253 510220

##### Chairman

Luís Augusto Rocha  
e-mail: [lrocha@dem.uminho.pt](mailto:lrocha@dem.uminho.pt)  
fax: +351 253 516007  
phone: +351 253 510231

Universidade do Minho  
Dept. Engenharia Mecânica  
Campus de Azurém  
P-4800-058 Guimarães  
Portugal

# Program & Book of Abstracts



## International Symposium on Multiscale, Multifunctional and Functionally Graded Materials

25-29 September 2010

Multiscale, Multifunctional and Functionally Graded Materials

ECT

TAGUS

T2M



Monday, 27<sup>th</sup> September 2010 (AFTERNOON)

14h	<p align="center"><b>Plenary Lecture (Auditorium)</b>  <b>E. Fortunato – Multifunctional oxide materials</b>  <small>Universidade Nova de Lisboa, CENIMAT – Portugal</small></p>		
	AUDITORIUM	ROOM S1	ROOM S2
	SESSION A3 – Chair: <i>Ryuzo Watanabe; Ana Maria Pinto</i>	SESSION B3 – Chair: <i>Akira Kawasaki</i>	SESSION C3 – Chair: <i>Rosa Miranda; Alexandre Velinho</i>
15h	Carbon nanotube-reinforced aluminium matrix composites by combined process of SPS pre-sintering and hot extrusion <i>A. Kawasaki, H. Kwon</i>	FGM thermal barrier coatings under hot burner testing <i>M. Gasik, A. Kawasaki</i>	Influence of roving linear density and reinforcement structural density in textile reinforced concrete performance <i>C. Gonilho-Perelra, R. Figueiro, P. Pina Marques, M. Araújo</i>
15h20	Optimum conditions for the compaction of compositionally graded powder stack <i>R. Watanabe, C.-H. Yeh, A. Kawasaki</i>	Rear earth silicate based environmental barrier coating on silicon nitride ceramic <i>Z. Negahdari, S. Pontiller, M. Willert-Porada</i>	Self-monitoring composite rods: properties assessment <i>C. Gonilho-Pereira, R. Figueiro, K. Rosado, S. Lanceros-Mendez</i>
15h40	Processing and shear stress evaluation of functionally graded composites with different gradient profiles <i>O. Carvalho, D. Soares, F.S. Silva</i>	Analysis of ceramic/metal functionally graded thermal barrier coatings in service <i>S.-Y. Yang, Q.-J. Zhang, P.-C. Zhai, L.-S. Liu</i>	Producing FGMs by FSP – a preliminary study <i>R.M. Miranda, J. Gandra, A. Velinho, P. Vliça, J. Pamies Teixeira</i>
16h-16h20	Coffee Break		
	ROOM S1	ROOM S2	
	SESSION B4 – Chair: <i>Zahra Negahdari</i>	SESSION C4 – Chair: <i>Eduardo Salz</i>	
16h40	Design and Joining of graphite to copper by a simple direct casting technology <i>Z. Zhou, Z. Zhong, X. Cui, C. Ge</i>	Mechanical performance of graded metal ceramic interfaces obtained by powder metallurgy <i>B. Henriques, D. Soares, F. Silva</i>	
17h	Development of tungsten coatings used as plasma facing materials for fusion reactor <i>S.Q. Guo, Z.J. Zhou, S.X. Song, C.C. Ge, Y.B. Feng</i>	Sintering strategy for defect-free BTS2.5/BTS5/BTS7/BTS10 functionally graded materials <i>S. Marković, S.D. Škapin, I. Balać, P.S. Uskoković, D. Suvorov, D. Uskoković</i>	
17h20	Strong magnetic field induced preparation of graded materials <i>Z. Sun, M. Guo, J. Vleugels, B. Blanpain, O. Van der Biest</i>		
18h	Guided Tour to the Historical Town of Guimarães (Departure: Centro Cultural Vila Flor; Arrival: Paço dos Duques de Bragança)		
19h	Port Wine Party (Paço dos Duques de Bragança – Building from the XV Century)		



Tuesday, 28<sup>th</sup> September (MORNING)

9h	<p align="center"><b>Plenary Lecture (Auditorium)</b>  <b>E. Saiz – Bio-Inspired hybrid composites with complex hierarchical structures</b>  <small>Imperial College, Dep. of Materials - UK</small></p>	
	ROOM S1	ROOM S2
	SESSION B5 – Chair: <i>Emilio Silva</i>	SESSION C5 – Chair: <i>Chang-Chun Ge</i>
10h	<p><b>Functionally graded viscoelastic pavement analysis with stress-dependent substrate, Part-I: Theory and development</b>  <u>E.V. Dave</u>, K. Park, G.H. Paulino, W.G. Buttler</p>	<p><b>Study of strength and toughness in Japanese sword produced by Tamahagane steel by Tataro process</b>  <u>M. Yaso</u>, T. Takaiwa, Y. Minagi, T. Kanaizumi, K. Kubota, Y. Noda, A.K. Das, S. Morito, T. Ohba</p>
10h20	<p><b>Functionally graded viscoelastic pavement analysis with stress-dependent substrate, Part-II: Applications</b>  <u>E.V. Dave</u>, K. Park, W.G. Buttler, G.H. Paulino</p>	<p><b>Micro-wire interface debonding and toughening of metal-ceramic matrix composites with inter-penetrating structures by spontaneous infiltration</b>  <u>J.M. Vieira</u>, M.X. Gao, X.S. Yi, Y. Pan, F.J. Oliveira, J.L. Baptista</p>
10h40		<p><b>Fabrication and interface phase characterization of tungsten/iron FGM by resistance sintering combined with ultra high pressure</b>  <u>D. Qu, Z. Zhou</u></p>
11h-11h20	Coffee Break	
	SESSION B6 – Chair: <i>Eshan Dave</i>	SESSION C6 – Chair: <i>Muneo Yaso</i>
11h20	<p><b>Transient thermal fracture analysis of orthotropic functionally graded materials using <math>J_k</math> – Integral</b>  <u>S. Dag</u>, B. Yildirim</p>	<p><b>Fabrication and characterization of 4 mm thick tungsten coatings on copper alloy for nuclear fusion reactor applications</b>  <u>S.Q. Guo</u>, Y.B. Feng, C.C. Ge, Z.J. Zhou, H.B. Zhou, C. Wang</p>
11h40	<p><b>Braided composite rods optimal design assessment</b>  <u>C. Gonilho-Pereira</u>, R. Figueiro, S. Jalali, M. Araújo</p>	<p><b>Finite element analysis of solid oxide fuel cells with functionally graded electrodes</b>  <u>G. Anandakumar</u>, N. Li, J.-H. Kim</p>
12h	<p><b>Numerical simulation on the impact resistance of functionally graded materials</b>  <u>J. Zhang</u>, M. Zhang, P. Zhai</p>	<p><b>Functionally graded electroactive poly(vinylidene fluoride) by multilayer spin-coating deposition with controlled crystalline phase content</b>  <u>V.F. Cardoso</u>, G. Minas, S. Lanceros-Méndez</p>
12h20-14h	Lunch	

## BRAIDED COMPOSITE RODS OPTIMAL DESIGN ASSESSMENT

C. Gonilho-Pereira<sup>1</sup>, R. Figueiro<sup>2</sup>, S. Jalali<sup>1</sup>, M. Araújo<sup>3</sup>

<sup>1</sup>C-TAC - Territory, Environment and Construction Centre, Dpt. Civil Engineering, University of Minho, Guimarães, Portugal; [cristiana.pereira@civil.uminho.pt](mailto:cristiana.pereira@civil.uminho.pt)

<sup>2</sup>FMRG – Fibrous Materials Research Group, Centre of Textile Science and Technology, Dpt. Textile Engineering, University of Minho, Guimarães, Portugal

<sup>3</sup>Centre of Textile Science and Technology, Dpt. Textile Engineering, University of Minho, Guimarães, Portugal

The concrete construction industry deals every day with the deterioration of concrete structures. Corrosion of steel is one of the most serious problems of concrete structures. Several techniques have been developed to reduce corrosion of steel but none seems to be a suitable solution for the corrosion problem. Therefore, the use of fibre reinforced composite rods as concrete reinforcement material seems to be an effective solution to overcome durability problems of traditional steel reinforced concrete structures. The main advantages of fibre reinforced composite materials over steel include the excellent corrosive resistance, mechanical properties similar to steel, high strength-to-weight ratio and excellent fatigue resistance, among others. Thus, the replacement of steel rebars with fibre reinforced composite rods is gaining popularity worldwide.

Typically, fibre reinforced composite rods are produced by pultrusion, although, besides this technique, fibre reinforced composite rods can also be produced using braiding techniques. Braiding is a conventional textile technique, low cost, that allows in-plane multiaxial orientation, conformability, excellent damage tolerance and core reinforcement. Moreover, allows the production of ribbed structures and a wide range of mechanical properties may be achieved when the braided fabrics core are reinforced with the appropriate type of fibres.

The current work is concerning the development of braided reinforced composite rods for civil engineering applications. The main objective of this research work is the development of a corrosion resistant material for concrete internal reinforcement, in order to overcome the main disadvantage of steel, e. g. corrosion. Moreover, it is intended to produce composite rods with ribbed surface in a single step production process. Thus, using conventional textile techniques, composite rods will be produced with a polymeric matrix reinforced by braided structures with different types of high performance fibres as axial reinforcement.

The research study aims to understand the mechanical behaviour of braided reinforced composite rods produced from an innovative technique. Several types of braided reinforced composite rods were produced, varying the type of fibres used as core reinforcement of a polyester braided fabric. The mechanical properties of the braided reinforced composite rods were evaluated under tensile in order to identify the type(s) of fibre(s) to be used as core reinforcement.

**Keywords:** Fibres; Optimal design; Composite rod; Concrete.

## NOTES