IRT JULES VERNE

Sujet de thèse Doctorat	**N°Fiche DER/4.18**

Sujet : **Développement of nanoreinforced structural composites parts for windmill blades' health monitoring**

Nom de projet : EVEREST	Date de début : 01/03/2014
Encadrants : Prof. Jean-François FELLER (Smart Plastics Group, LIMATB-UBS, Lorient) & Prof. Jean-Christophe SANGLEBOEUF (LARMAUR, Univ. Rennes 1)	Localisation : LIMATB, UBS, Lorient

Présentation du contexte et du sujet de thèse

In a highly dynamic context of renewable marine energy production (EMR), the EVEREST project funded by the Institute of Research & Technology (IRT Jules Verne) aims at developing a demonstrator of windmill part based on high-performance intelligent composite materials, namely nano- and micro- reinforced polymer matrices, also capable of health monitoring. The performances of quantum resistive nanocomposite sensors to follow deformation and damage will be compared to those of classical optical fibre and ultrasonic sensors. The nanoreinforcement behaviour will be investigated by nanoindentation.

This partnership is associating companies such as Alstom Group (one of the world leaders in energy production), Europe Technologies (specialized in monitoring and control of materials), to academics partner such as LIMAT[B] (development of smart nanocomposites for sensing and nanoreinforcement), LARMAUR (mechanical properties of materials), IFSTTAR (creep, fatigue of composite materials), ENSAM (modelling of composites properties).

The research will be done in the Smart Plastics Group of LIMAT[B] (UE4250) at the University of South Brittany (UBS) for the development of nanoreinforced composites and electrically conductive polymer nanocomposites (CPC) for the design of strain and damage sensors [1-3], with frequent stays in the LARMAUR at the University of Rennes 1, for the investigation of mechanical properties at the nanoscale [4-5].

Schematically the different steps of the work will be to:
- ⇨ Integrate the prior state of art at LIMAT[B] & LARMAUR in the field of composites, nanocomposites and mechanical properties characterization and modelling,
- ⇨ Develop and characterize samples of nanoreinforced composite parts, integrating sensors for the monitoring of their elongation and damage,
- ⇨ Characterization of piezo-resitive and nanomechanical properties induced by carbon nanofillers
- ⇨ Modelling of the mechanical and electrical properties
- ⇨ Deployment of a quantum resistive sensors' (QRS) network in large parts of windmills.

References

1. S. N. Chowdhury, I. Pillin, M. Castro, P. Longrais, J. F. Feller, Health monitoring in core of poly(epoxy)/glass fibre composites with Conductive Polymer nanoComposite piezo-resistive sensors, Polytech - International Conference on Advances in Polymeric Materials & Nanotechnology, 15-17 December 2012, Pune, India.
2. C. Robert, J. F. Feller, M. Castro, Sensing skin for strain monitoring made of PC-CNT conductive polymer nanocomposite sprayed layer by layer, ACS Applied Materials & Interfaces, 4,7, 3508–3516 (2012).
3. Z. Levin, C. Robert, J. F. Feller, M. Castro, J. C. Grunlan, Flexible latex - polyaniline segregated network composite coating capable of measuring large strain on epoxy, Smart Materials & Structures, 22, 015008, 1-9 (2013).
4. C. Bernard, V. Keryvin, J. C. Sangleboeuf, T. Rouxel, Indentation creep of window glass around glass transition, Mechanics of Materials, 42, 2, 196-206 (2010).
5. P. Lucas, E. A. King, Y. Gueguen, J. C. Sangleboeuf, V. Keryvin, R. G. Erdmann, G. Delaizir, C. Boussard-Pledel, B. Bureau, X. H. Zhang, T. Rouxel, Correlation between thermal and mechanical relaxation in chalcogenide glass fibers, Journal of the American Ceramic Society, 92, 9, 1986-1992 (2009).

Compétences

Applicants should hold a Master or Engineer degree in polymer composites materials, mechanics and materials or nanotechnology. A background in synthesis and characterization of nanocomposites will be appreciated. Ideally, he/she should also have some expertise in nanomaterials processing and characterization. Team capability, organizational talents and very good skills in English are required.

Profil

Master or Engineer degree in polymer composites materials, mechanics and materials or nanotechnology

Contact	Merci de bien vouloir envoyer un CV détaillé, une lettre de motivation et une lettre de référence à : recrutement@irt-jules-verne.fr
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