Functional oxides for energy efficiency : combinatory synthesis and nanostructuration

Oxides are easy to fabricate, low cost, health and environmental friendly and stable in a large range of temperatures. They have a variety of magnetic, mechanic and electric properties which make them essential materials in many fields related to energy efficiency. These properties, often resulting from multiple interactions in competition, vary rapidly according to the composition and their dimensionality (crystals, thin films, massive ceramics, nanopowders, nanowires ...). They also depend on the intrinsic interfaces of materials (grain boundaries ...) or artificial interfaces (composite materials, multilayers). In addition, functionality and performance depend on the micro and / or nanostructure (porosity, exchange surface and stress response).
GREMAN has adopted a multi-scale material approach that addresses issues from the fundamental to the application. The properties targeted by the oxide materials and devices integrating them, concern three aspects of energy efficiency :

- Energy harvesting by thermoelectric or piezoelectric effect.
- Energy storage (micro-batteries Li or Na with nano-structured electrodes, power capacities with materials with high dielectric permittivity).
- Reducing the energy consumption using materials with adjustable permittivity, permeability or emissivity.

Ongoing projects

CONTRACTS ON PUBLIC FUNDING

« LOTTE » : PIA Tours 2015 Project - Future investments for nanoelectronic (2015-2016). Project's leader: GREMAN. Partners : ST Microelectronics.

« **METEO** » : MicrogEnerateur ThermoElectrique a base d'Oxydes - Project of Region Centre-Val de Loire (2015-2018). Coordinator : GREMI. Partners : Laboratoire GREMI (Universite d'Orleans), Laboratoire GREMAN (Universite de Tours), Laboratoire CRISMAT (Universite de Caen), ST Microelectronics.

International post doc grant - Universite de Tours (2015-2016).

« **SIBERSITTE** »: Sodium Ion Batteries : EneRgy for the Strategy of Innovation in the cenTer rEgion - Project of Region Centre-Val de Loire (2016-2019). Coordinator : CEA Le Ripault, Societe VLAD (Tours). Partners : Laboratoire GREMAN (Universite de Tours), Laboratoire PCM2E (Universite de Tours).
« **INTIM** »: INTerfaces in thin fiIMs - Capacitors 2015 - Project of Region Centre-Val de Loire (2012-2016). Project's leader : GREMAN (A Ruyter). Partners : Laboratoire ICMN (Universite d'Orleans).
« **PROMESTOCK-SPS** » : Acquisition d'un equipement de frittage par Spark Plasma Sintering (SPS) pour l'activite de nombreux projets du laboratoire GREMAN et des laboratoires materiaux Orleans-Tours (2015-2017). Financer : FEDER/CPER Region Centre Val de Loire. Project's leader : GREMAN (I. Monot-Laffez).

CONTRACTS ON PRIVATE FUNDING

« **PROH2-FIAPIBERO** » : Mecanisme de vieillissement et degradation des ceramiques dans les piles electrochimiques (2015-2016) - Project of Region Centre-Val de Loire/CEA. Project's leader : GREMAN (C Autret). Partners : GREMAN (Universite de Tours), CEA Le Ripaut.

« **COCONUT** »: Core-Shell" structure materials for multilayer ceramic capacitors with a high capacitance - Projetc of Region Centre-Val de Loire (2014-2017). Project leader : GREMAN (C Autret). Partners : Laboratoire GREMAN (Universite de Tours), SRT Microceramique (Vendome).
« **SUPERHOX** » : Supercondensateurs de haute energie a base d'oxydes nanotextures - Region Centre-Val de Loire project (2014-2016). Project's leader : CEHMTI, Universite d'Orleans. Partners : laboratoire GREMAN (Universite de Tours), laboratoire CEMHTI (Universite d'Orleans), CEA Le Ripault.
« **STOCKE-DEPOYDE** » (Lavoisier) : Depot d'oxyde par voie polymerique sur substrat structure 3D - Project of Region Centre-Val de Loire/CEA (2015-2016). Project's leader : GREMAN (N. Poirot). Partners : Laboratoire GREMAN (Universite de Tours), Laboratoire PCM2E (Universite de Tours) CEA Le Ripault.
« **K-NNOPEE** » : (K, Na) NiObates dopes pour de nouveaux PiEzoElectriques - Project of Region Centre-Val de Loire (2014-2017). Project's leader : GREMAN (I. Monot-Laffez). Partners : Laboratoire GREMAN (Universite de Tours), LSPM paris 13, ISTO universite Orleans, Ste Vermon Tours.

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