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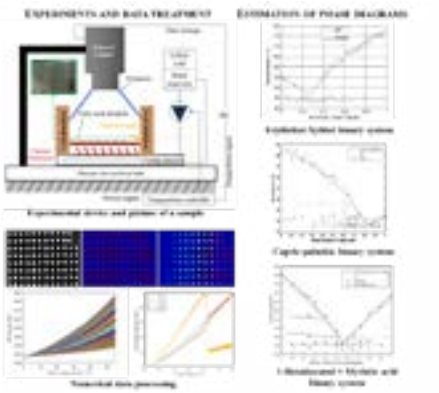
Fast screening of binary systems of phase change materials for thermal energy storage

The SUDOKET project aims to map, consolidate and disseminate Key Enabling Technologies (KETs) for the innovative building sector. Thermal energy storage is one of the key elements to optimize the use of available energy resources (especially renewable ones) and to improve the energy efficiency of buildings. Phase change materials (PCMs) used for the thermal energy storage are an important class of materials which substantially contribute to the efficient use and conservation of waste heat and solar energy. In this framework, our objective is to develop and study new biosourced phase change materials, able to compete with water as storage material and presenting improved performances in comparison with currently used PCM (i.e: low cost, high energy density, low ecological impact …). Among organic PCMs, fatty acids (FAc), fatty alcohols (FAl) and sugar alcohols (SA) are promising candidates. In order to select the most suited binary systems of the latters, a screening step must to be performed. To establish the phase diagrams of materials, the most common methods used are the Differential Scanning Calorimetry (DSC) and the Differential Thermal Analysis (DTA) but the determination of a reliable phase diagram via those standard methods is really time consuming and poorly adapted to screening procedures. An innovative method based on infrared thermography (IRT-method) was first developed in the framework of the European FP7 Research Project SAM.SSA (2012-2015) for the screening of SA-SA binary systems [1], then improved and adapted to binary systems presenting more complex phase diagrams with peritectic, metatectic transitions (FAc-FAc, FAc-FAl) [2]. IRT-method allows establishing their preliminary phase diagram in only a few hours instead of several weeks and was validated confronting the obtained results to data extracted from literature, to experimental data obtained using DSC and to values assessed by thermodynamical models.



Recent Publications

1. Palomo del Barrio E, Cadoret R, Daranlot J and Achchaq F (2016) Infrared thermography method for fast estimation of phase diagrams, Thermochimica Acta, 625:9-19.
2. Mailhé C, Duquesne M, Palomo del Barrio E, Azaïez M and Achchaq F (2019) Phase diagrams of fatty acids as biosourced phase change materials for thermal energy storage, Applied Sciences, 9:1067-1078.
3. Maximo G J, Carareto N D D, Costa M C, dos Santos A O L, Cardoso P, Krähenbühl M A, Meirelles and A J A (2014) On the solid–liquid equilibrium of binary mixtures of fatty alcohols and fatty acids. Fluid Phase Equilibria 366:88-98.

Biography

Marie Duquesne defended her PhD "Resolution and reduction of a non-linear energy storage model by adsorption on zeolites" in 2013 at the University of Bordeaux. She is Associated Professor at the Institute of Technology of Bordeaux since 2015 and Researcher at TREFLE Department (Fluids & Transfers) of I2M (Institute of Mechanics and Engineering). She has expertise in thermal energy storage at low-to-medium temperatures. She contributed to the ANR Project SIMINTHEC (National Project, 2008-2011), to the European FP7 SAM.SSA Project (2012-2015) and contributes to the Interreg SUDOE European SUDOKET Project (2018-2021) and to the Region Nouvelle Aquitaine BioMCP project (2018-2021)..

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