Smart & Green Interfaces:
From Single Bubbles/Drops to Industrial/Environmental/Biomedical Applications
MP1106

Start date: 11/05/2012
End date: 10/05/2016
Year: *2*

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Chair

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COST is supported by the EU Framework Programme

ESF provides the COST Office through a European Commission contract

Scientific context and objectives (1/2)

- **Background / Problem statement:**

scientific context:

– Bubble & drop interfaces are fundamental to: industrial applications, environmental applications, biomedical applications.

Innovation

- **Smart** interfaces can accomplish a technological task with high efficiency, adaptability and selectivity
- **Green** interfaces are eco-friendly (biodegradable, reusable, more durable, less energy consuming to produce).

Objectives:

– Identify and implement best strategies and means to tailor Smart & Green interfaces and accurately control their performance by concerted action of the most active European research institutes and companies in the field

– To organize a Europe-wide interdisciplinary cooperation platform directed towards scientific added value and improvement of industrial/environmental/medical applications concerning interfaces, bubbles and drops

Scientific context and objectives (2/2)

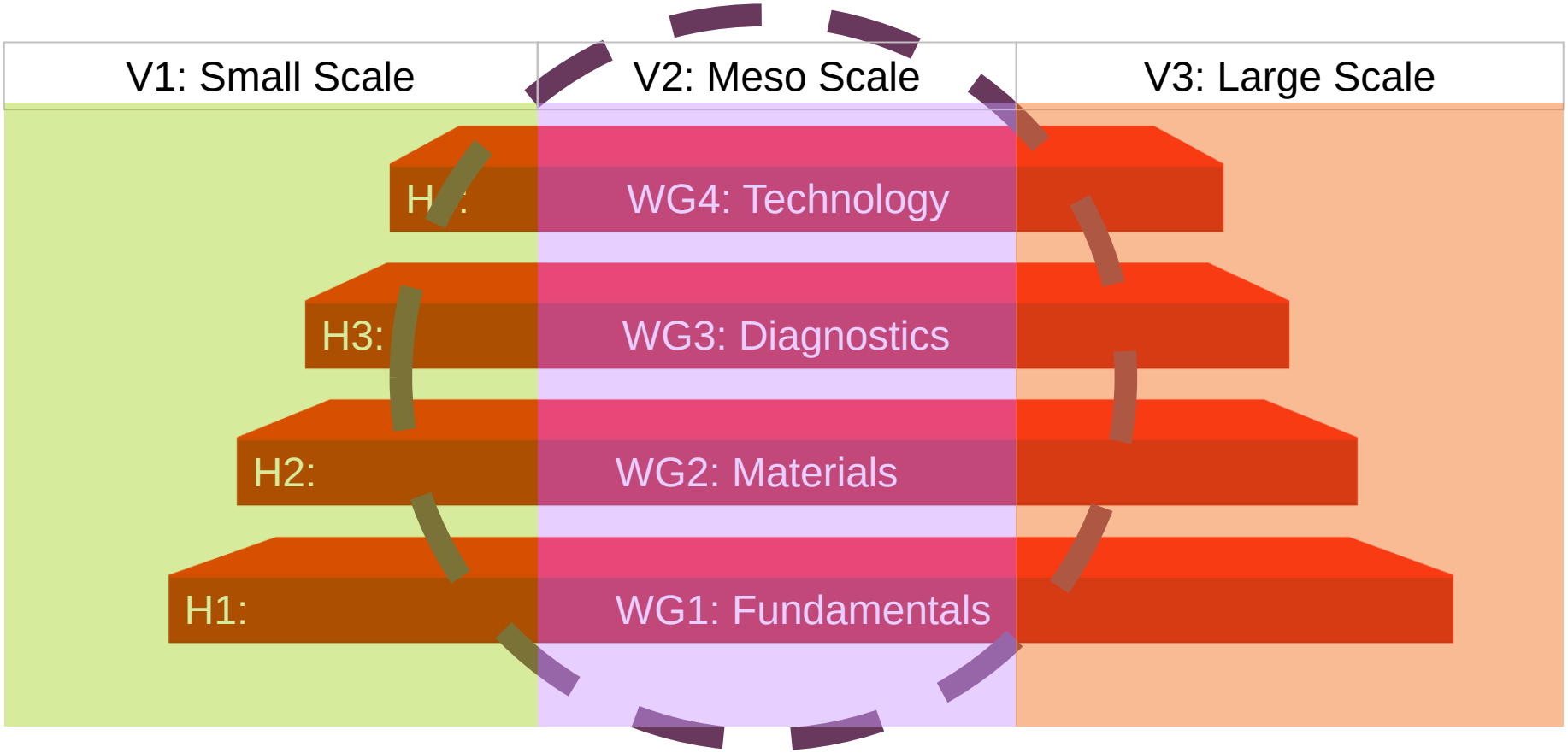
1. Improvement of the **fundamental understanding** of interface structure and its evolution by combining theoretical development, novel numerical techniques and novel experimental techniques.

2. Development of **new materials** relevant to creation of Smart and Green interfaces e.g. surfactants, macromolecules, structured solid surfaces, solid foams or aerosol particles.

3. Development of novel and improvement of existing **diagnostic techniques**. They refer to properties of single or multiple interfaces and to general real/life applications (e.g. medical diagnosis)

4. Development or improvement of marketed **industrial technologies**. These span from consumer end-products to classical industrial processes and to computational tools for design and optimization.

Working groups

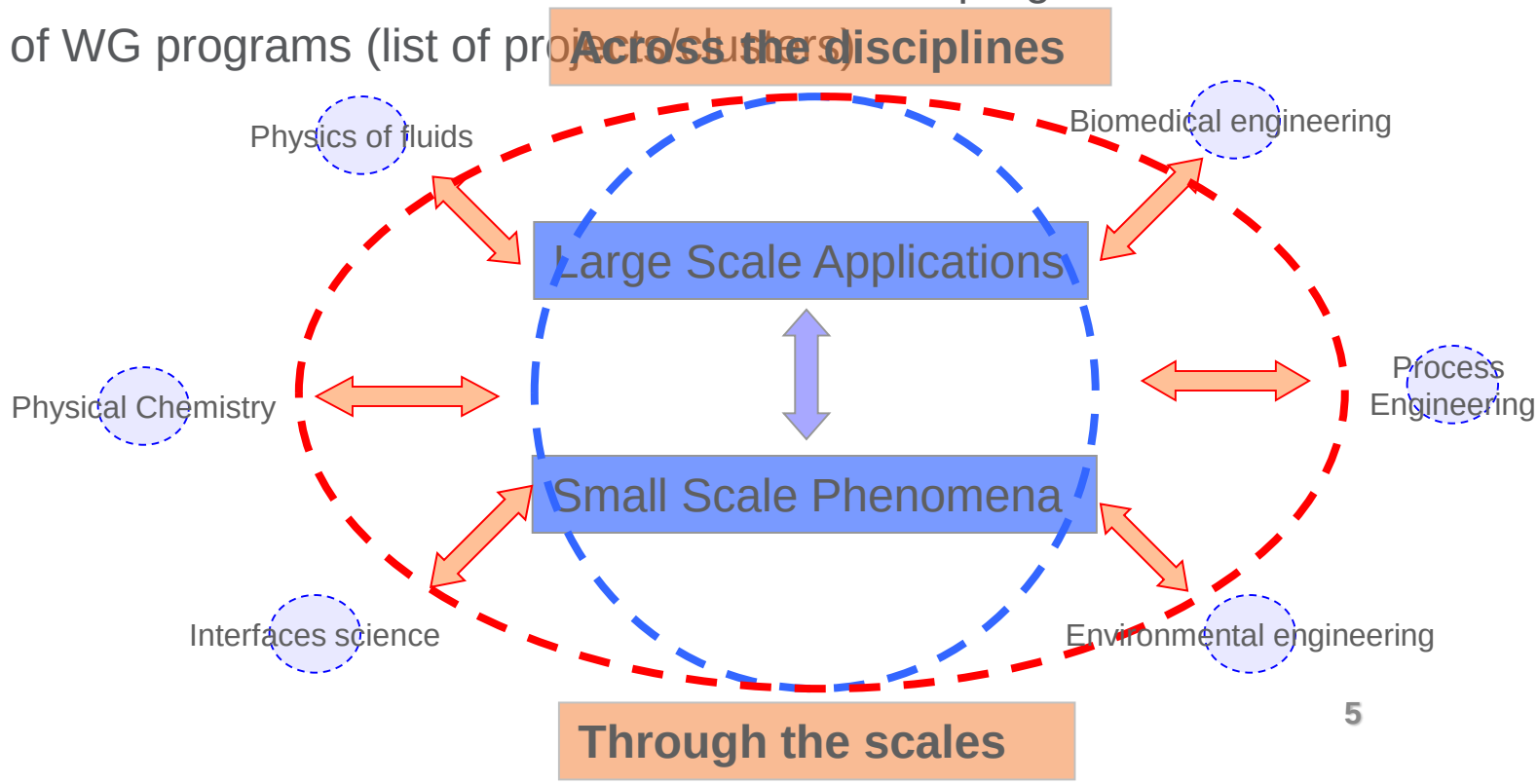


- A **flexible & open framework** enabling new groups to join and integrate into the project

Results vs. Objectives

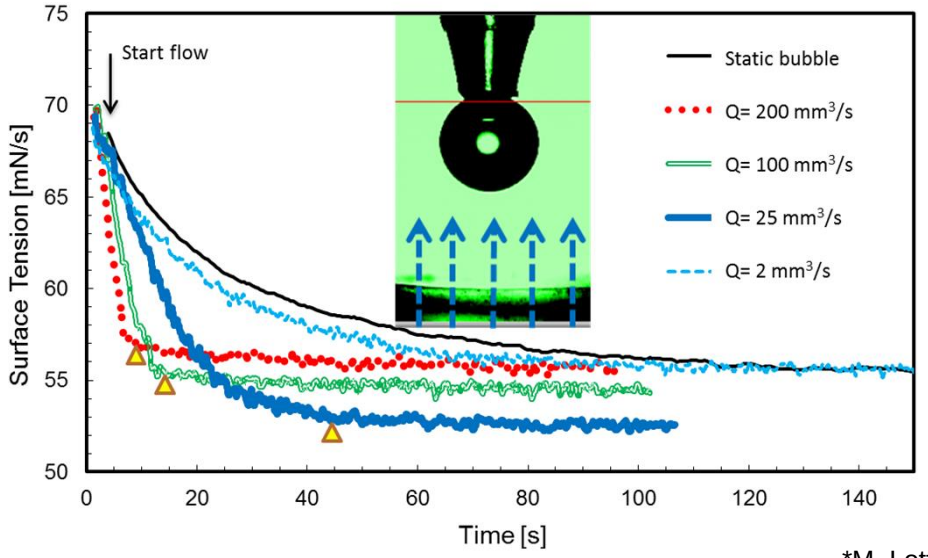
- Fine tuning of the Action's activities and adjustment from what in the MoU
- Identification of current knowledge gaps regarding scientific/technological goals
- Detection of ways to overcome e
- Collection of information about the EU, national, industrial programs on interfaces
- Preparation of WG programs (list of projects/clusters)

Added value of **networking**



Significant Highlights in Science and Networking

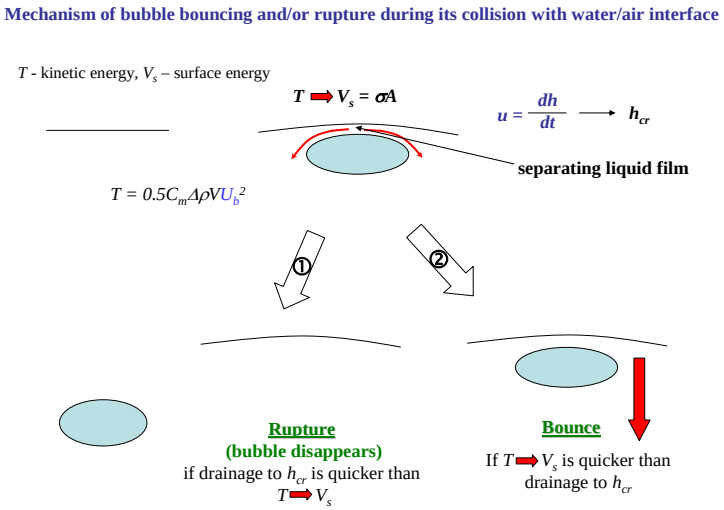
A new type of experiments was designed by a MPI group in Golm that mimics the situation of a bubble rising in a surfactant solution (*). By fixing the bubble at the tip of a capillary and positioning it into a liquid flow field, access is obtained of the capillary pressure in the bubble in real time. Similar experiments appear to be feasible also for drops in a flow field

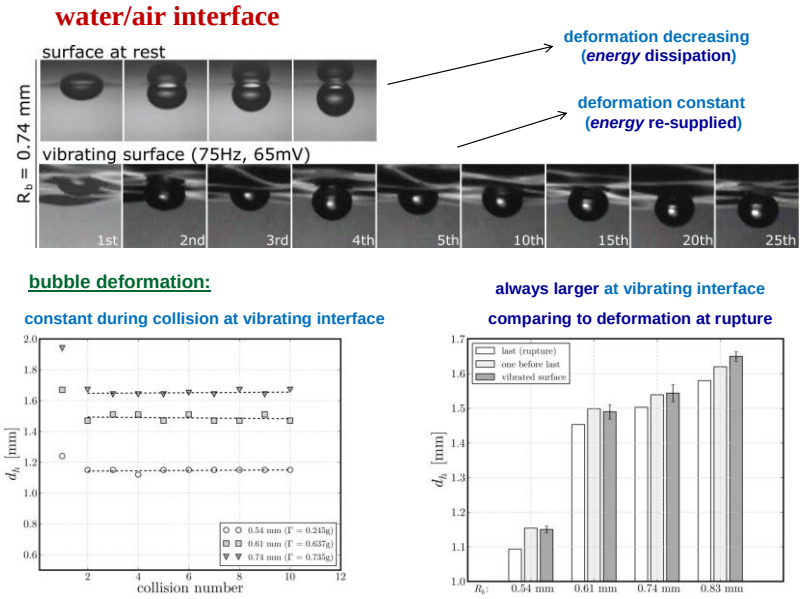


*M. Lotfi, D. Bastani, V. Ulaganathan, R. Miller and A. Javadi, Bubble in flow field: a new experimental protocol for investigating dynamic adsorption layers by using capillary pressure tensiometry, Colloids and Surfaces A, in press

Significant Highlights in Science and Networking

An experimental proof of the hypothesis was provided by a group at PAN in Krakow that if the kinetic energy, associated with the bubble motion, is re-supplied to the bubble colliding with surface of ultra-pure water (devoid of any surface active substances) then the bubble bouncing can be prolonged indefinitely and the bubble does not rupture.

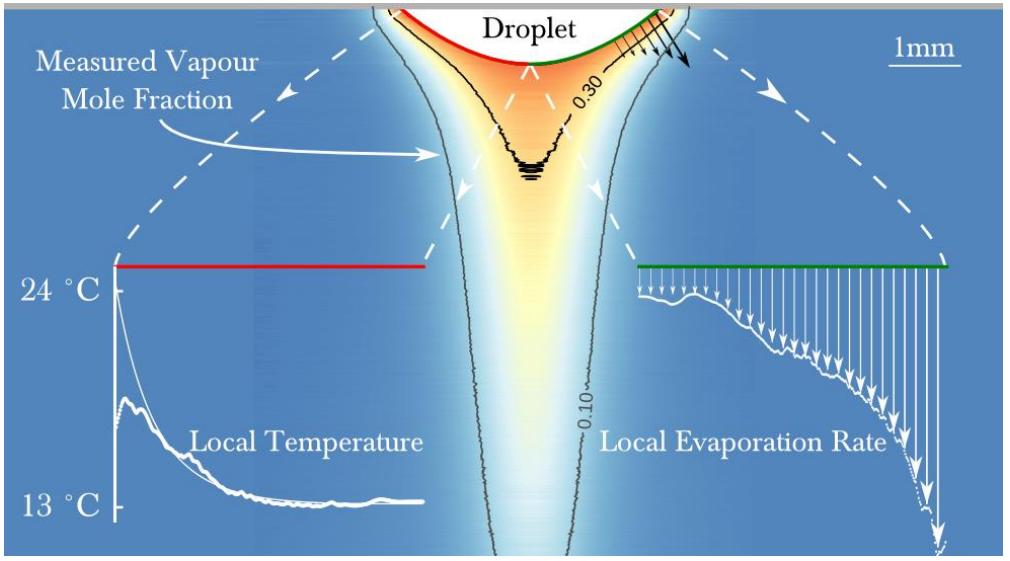




*Kosior, D., Zawala, J., Todorov, R., Exerowa, D. & Malysa, K. 2013, "Bubble bouncing and stability of liquid films formed under dynamic and static conditions from n-octanol solutions", Colloids and Surfaces A: Physicochemical and Engineering Aspects.

Significant Highlights in Science and Networking

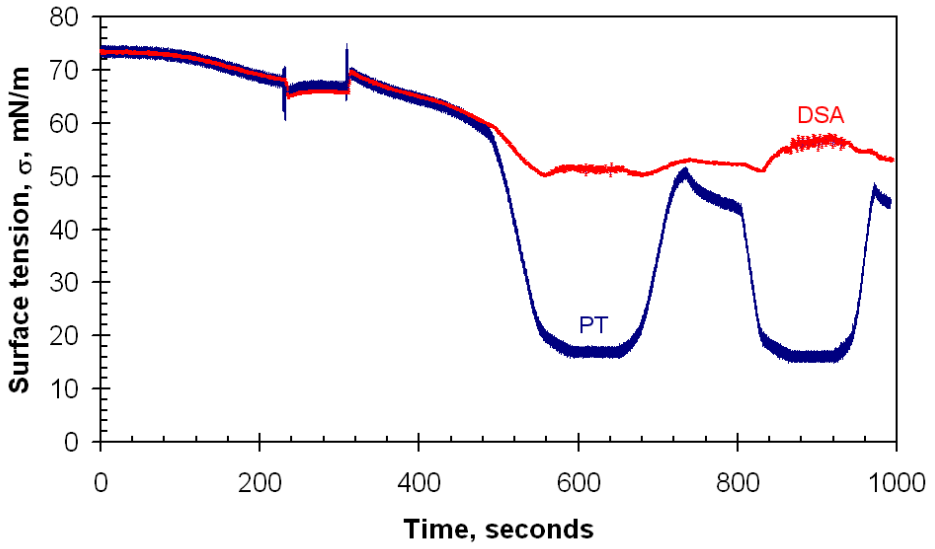
Using Digital Holographic Interferometry, a group in Université Libre de Bruxelles, was able to quantify the vapor mole fraction field surrounding an evaporating pending droplet. From this field, they were able for the first time to extract local evaporation rates and temperatures along the interface of the droplet as well as obtain an instantaneous global evaporation rate measurement.



* S. Dehaeck, A. Ye. Rednikov and P. Colinet, "Vapour-based interferometric measurement of local evaporation rate and interfacial temperature of evaporating droplets", Langmuir 30, 2002–2008 (2014); doi: 10.1021/la404999z.

Significant Highlights in Science and Networking

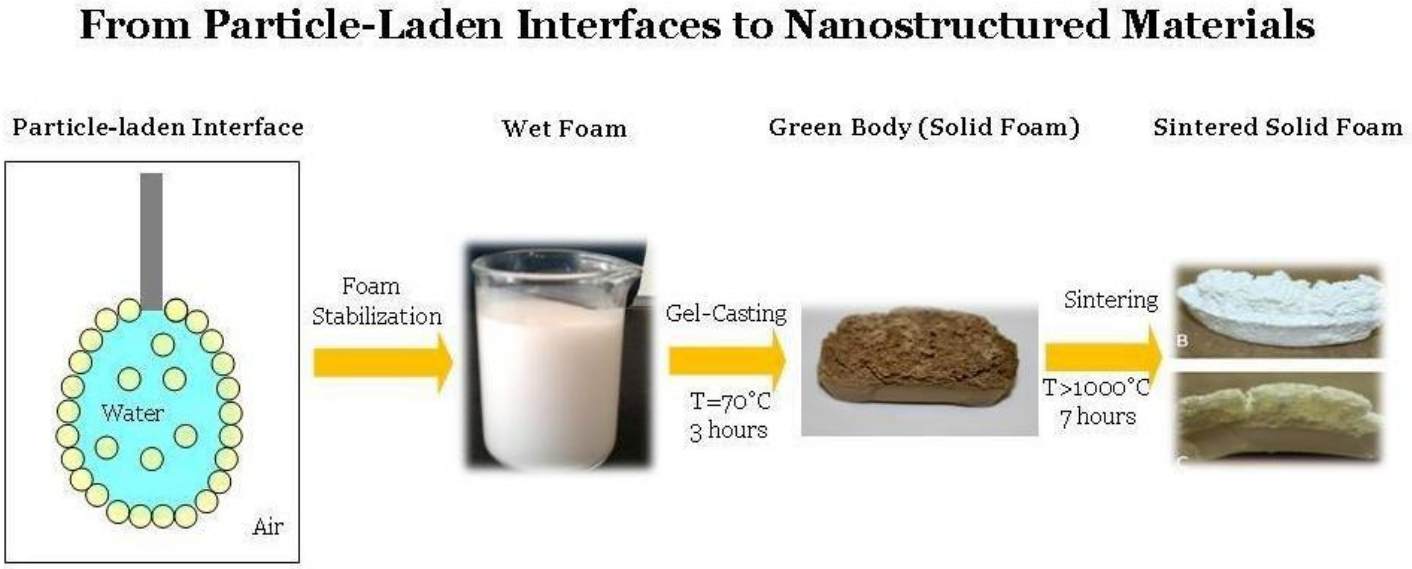
The pendant-drop method with drop-shape analysis (DSA) and capillary pressure tensiometry (PT) was applied by a group at the Sofia University to investigate the fluidity and surface dilatational rheology of adsorption layers. In contrast to the DSA, the CPT method detects a significant membrane pressure decrease, similarly to the measurements with a Langmuir trough. The applicability of the methods and the sources of errors are analysed and compared. The results are especially important for the many new applications involving highly elastic adsorption layers by solid particles, lipids, polymers, etc.



*Stanimirova, R., Marinova, K., Tcholakova, S., Denkov, N.D., Stoyanov, S. & Pelan, E. 2011, "Surface rheology of saponin adsorption layers", Langmuir, vol. 27, no. 20, pp. 12486-12498.

Significant Highlights in Science and Networking

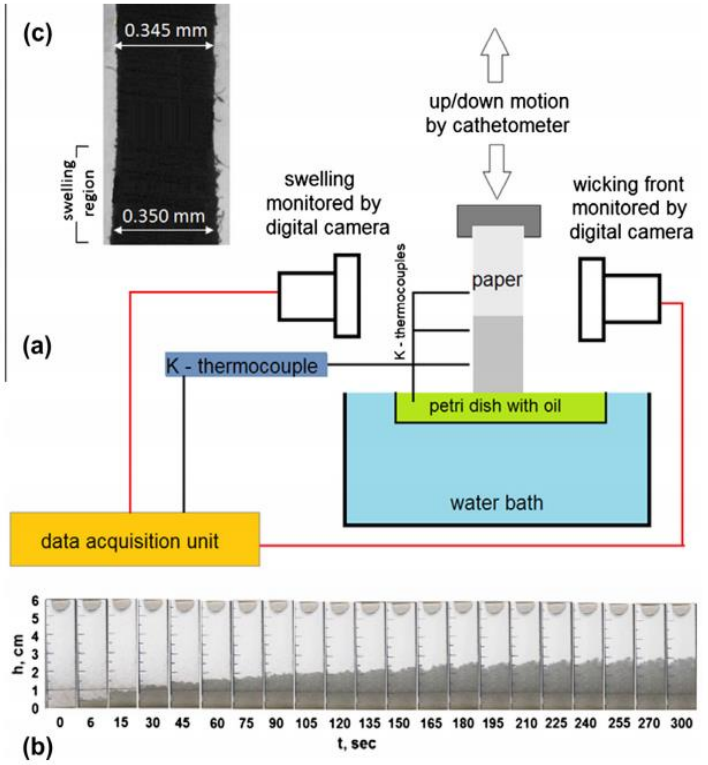
A group at the CNR in Genoa developed procedures and protocols to obtain microporous ceramic and carbonaceous materials from particle-stabilised foams. Correlations between the interfacial properties of the precursors liquids (water+particles+surfactants+additives) and specific morphological features of the material have been derived (*).



*D. Zabiegaj, et al. Colloids and Surfaces A: Physicochem. Eng. Aspects 438 (2013) 132– 140.

Significant Highlights in Science and Networking

A group at the Aristotle University of Thessaloniki provided experimental evidence that wicking speed (penetration rate of oil/gas interface) of oil into porous paper can be used as an effective rapid test to safely and easily distinguish fresh from prolonged fried oil.



*Lioumbas, J.S., Zamanis, A. & Karapantsios, T.D. 2013, "Towards a wicking rapid test for rejection assessment of reused fried oils: Results and analysis for extra virgin olive oil", Journal of Food Engineering, vol. 119, no. 2, pp. 260-270.

Significant Highlights in Science and Networking

• Organization of three (3) Workshop Meetings: 04-06.09.13, Sofia, 03-04.10.13, Zaragoza, 13-14.11.14, Cargese.

• Organization of the Annual Workshop “Smart and Green Interfaces”: 22-24.04.14, Marseilles.

• Organization of the one (1) Core Group Meeting: 13-12-2013, Teleconference.

•Three (3) training schools: 16-18.07.2013, Thessaloniki, 02-05.04.2014, Bonassola, 05-10.05.2014, Darmstadt.

Significant Highlights in Science and Networking

- 12 STSMs
- 88 joint publications have been published or submitted for publication
- Several joint research proposals have been submitted both to EU and to national programmes, some of which have been accepted for funding
- Round tables in annual workshop on the formation of partner clusters targeting specific applications with the aim to submit proposals for Horizon 2020 Research Calls

Future Plans

Networking

- Transfer of knowledge within the partners, exchange of persons, facilities, samples, sharing data and knowledge.
- Establish interdisciplinary links between physicists, chemists, material scientists, engineers, mathematicians for manifold approach to complex problems identified within the WGs;
- Development of appropriate specific activities for ESRs.

Science

- Common understanding on the fundamentals, materials, diagnostics and technology related to smart and green interfaces applied to Industrial/Environmental/Biomedical Applications.
- Identification of current knowledge gaps/starting of activities to detect the ways to overcome existing gaps.
- Identification of horizontal thematic clusters across the four Working Groups in response to current and foreseen EU/Horizon 2020 Research Calls.

Future Plans

Activities

Meetings: **1.** MC Meeting, Annual Conference 2015, Piraeus, Greece

2. Core Group meeting, Teleconference

3. Combined WGs Meetings

A. Nanomaterials and Nanotechnologies -Nanostructured Materials for Water Treatment/Purification, Antalya, Turkey

B. Medical Diagnostics and Advanced Therapies, Sustainable Food Science and Technology, Thessaloniki, Greece

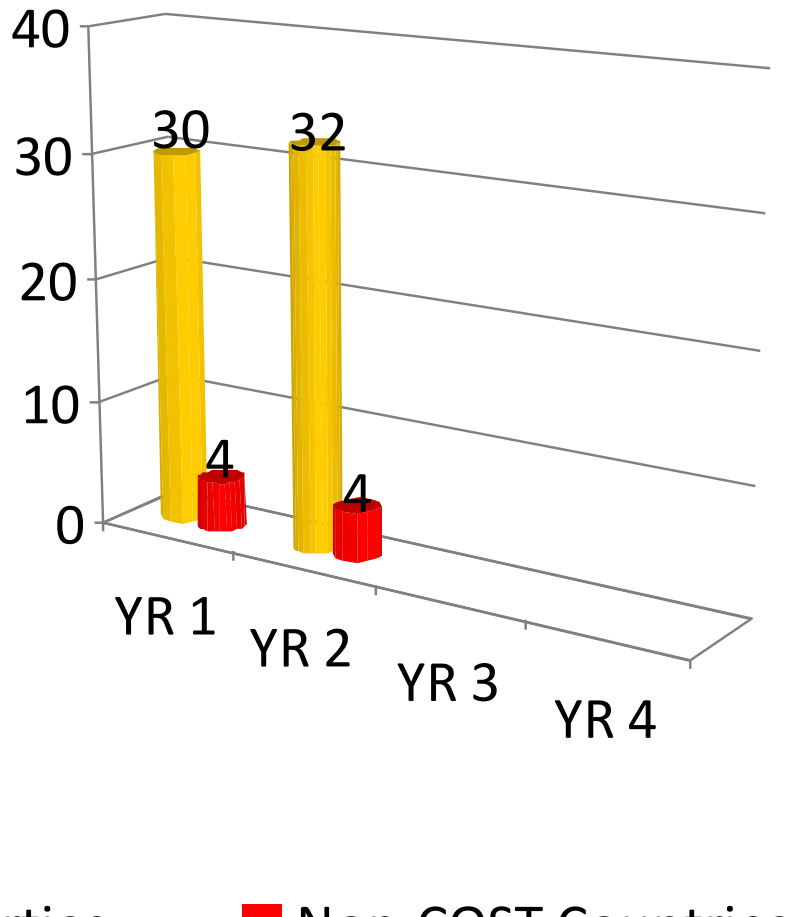
C. Heat and Mass Transfer on a Solid Substrate, Wetting of complex surfaces, Eindhoven, The Netherlands

Training Schools: **1.** Advanced Multi-physics Simulation Technology, Luxembourg city, Luxembourg

STSMs: 15

Appendix

Action Parties



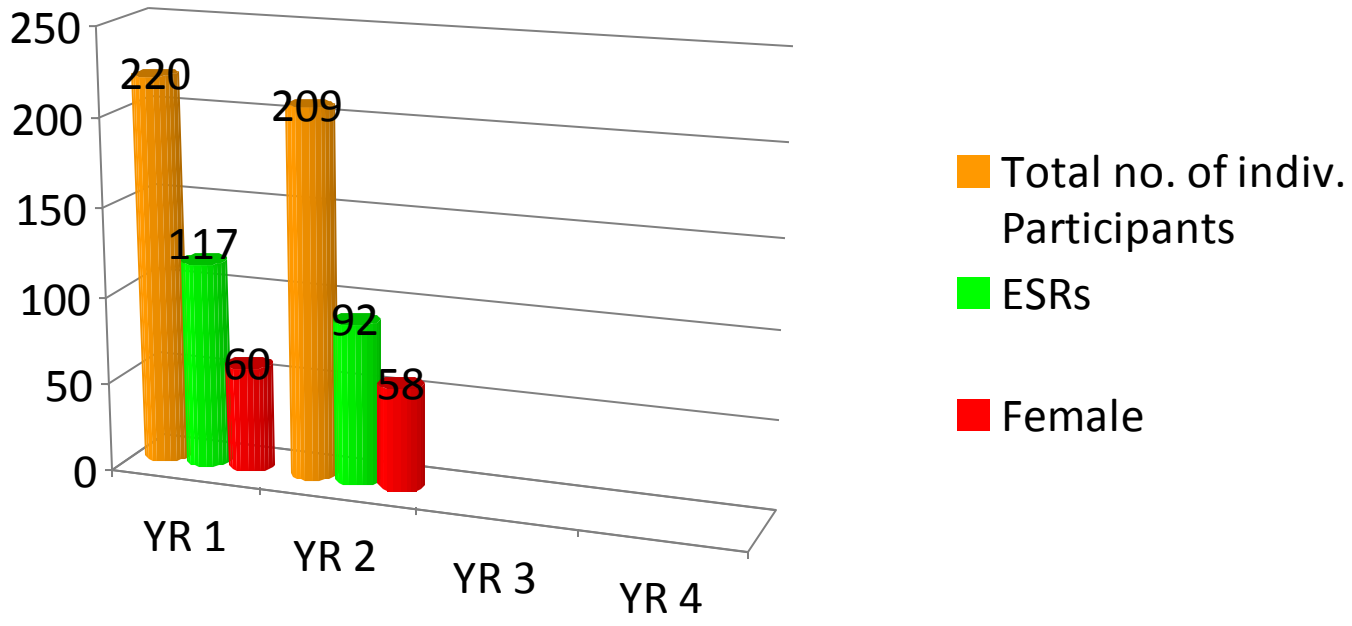
Grant Holder:

Aristotle University of Thessaloniki

Dr. John S. Lioumbas

Greece

Action participants



Use of COST Instruments

Activity MP1106	Year 1	Year 2	Year 3	Year 4
MC/WG Meetings	3	2		
STSMs	10	12		
Training Schools	1	3		
Workshops or Conferences	1	3		
Joint Publications	33	88		