High performance computing: methodologies and experiences at DIMA

C.M. Casciola

Dept. of Mechanical and Aerospace Engineering
Sapienza University

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Zeolite & Water

1 gr. = 6000 sqm. of interface
Activated drying in hydrophobic nanopores and the line tension of water

Ludivine Guillemot*, Thierry Bihen*, Anne Galarneau*, Gérard Vigier†, and Élisabeth Charlaix*‡,1

*Laboratoire de Physique de la Matière Condensée et Nanostructures, Université Lyon 1, Centre National de la Recherche Scientifique Unité Mixte de Recherche 5586, 69622 Villeurbanne Cedex, France; †Institut Charles Gerhardt Montpellier, Unité Mixte de Recherche 5253 Université Montpellier 2, École Nationale Supérieure de Chimie de Montpellier, Université Montpellier 1, 34296 Montpellier Cedex 5, France; ‡Laboratoire Matériaux Ingénierie et Sciences, Institut National des Sciences Appliquées de Lyon, 69621 Villeurbanne Cedex, France; and 1Laboratoire Interdisciplinaire de Physique, Université Joseph Fourier, Unité Mixte de Recherche 5588, 38402 St. Martin d'Hères, France

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Water Intrusion in Porous Materials

**Dampers**
[Guillemot et al. PNAS 2012]

**Molecular springs**
[Grosu et al. PCP 2016]
- Microscopic insights in intrusion/extrusion (hysteresis)
- Confined nucleation theory
* Nanoscale effects
* Design criteria for HLS (heterogeneous lyophobic systems)
- Negative extrusion pressure: $P_{ext} = -22$ MPa

- Asymmetric frequency dependence of intrusion and extrusion

- Both *intrusion* and extrusion are thermally activated events!

- Dissipated energy $\propto \ln f$
What About Complex Geometries?

Pore Morphology Determines Spontaneous Liquid Extrusion from Nanopores
Matteo Amabili, Yaroslav Grosu, Alberto Giacomello, Simone Meloni, Abdelali Zaki, Francisco Bonilla, Abdessamad Faik, and Carlo Massimo Casciola

ACS Nano, Just Accepted Manuscript • DOI: 10.1021/acs.nano.8b07818 • Publication Date (Web): 17 Jan 2019
Submersible Superhydrophobicity

(Salvinia Molesta)
Free energy profile @ $\Delta P \approx 0$

Work in Progress: Salvinia-Like Surfaces
(with V. Mattoli, F. Pignatelli, O. Tricinci - CMBR@IIT)

$h = 100 \, \mu m, \quad \Phi = 60 \, \mu m$

Esagonale, $\lambda = 100 \, \mu m$
Sketch of the Experimental Set-Up

- PDMS gasket
- SU-8 hydrophobic structures
- Droplet
- Pressure regulator
- Metal cannula
Details of Meniscus

External boundary layer

Intrusion meniscus radius
Bubble Collapse Near a Wall

International Journal of Multiphase Flow

Shock-induced collapse of a vapor nanobubble near solid boundaries
Francesco Magaletti, Mirko Gallo, Luca Marino, Carlo Massimo Gasciati

CrossMark
Continuum Model of Nucleation Dynamics: Fluctuating Hydrodynamics

Microfluidics: Blood-Vessel-on-a-chip

The Endothelial Barrier
How to enhance endothelial layer permeability

Enhanced Drug Extravatation

G. Peruzzi, G. Sinibaldi, G. Silvani, G. Ruocco, CMC, “Perspectives on Cavitation Enhanced Endothelial Layer Permeability”, Colloids and Interfaces B: Biointerfaces 2018
Blood-Vessel-on-a-chip

Tissue compartment

vascular channel

Gap Number

Area

0 500 1000 1500

US+MB recovery

US+MB
Turbulence


Mollicone, Battista, Gualtieri, CMC, JFM 2017
Coherent Structures ($\text{Re} = 10000$)
Particle Transport

\[ \text{St}^+ = 1 \]

\[ \text{St}^+ = 2 \]

\[ \text{St}^+ = 5 \]

\[ \text{St}^+ = 50 \]

\[ \text{St}^+ = 200 \]

\[ \text{St}^+ = 600 \]
The people in the group

Thank you!
carlomassimo.casciola@uniroma1.it
https://sites.google.com/a/uniroma1.it/flumacs/home