CURRICULUM VITAE

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H-Index (*GScholar*): 33
Citations (*GScholar*): 3743
Articles (*Scopus*): 114

RESEARCH SUMMARY

- Modelling of heat and mass transfer properties of **nanomaterials for energy and water applications**: colloidal nanosuspensions; polymer-based nanocomposites; nanoporous and hierarchical materials.
- Technical development and experimental test of **sustainable solar and water technologies** for: low-cost water desalination and sanitation; efficient thermal energy harvesting and storage; passive cooling.

WORK EXPERIENCE

11/2022 –

Associate Professor

Politecnico di Torino, Department of Energy & CleanWaterCenter

12/2019 – 10/2022

Tenure-track Assistant Professor - RTDb

Politecnico di Torino, Department of Energy & CleanWaterCenter

The assistant professorship is done at the Department of Energy and within the interdepartmental CleanWaterCenter of Politecnico di Torino.
Research activities focus on:

- Technical development and modelling of **evaporative coolers** and **thermal distillers** based on passive processes (e.g. capillarity, evaporation) rather than on mechanical components.
- Technical development and modelling of sustainable **textiles with radiative and evaporative cooling** features.
- Modelling heat transfer properties of **polymer-based composite materials** filled by carbon nanostructures.
- Modelling mass transfer of water in nanoporous inorganic or polymeric materials for **energy-efficient cooling or desalination.**
- Modelling over multiple scales of **nano-/micro-structured surfaces** with enhanced properties (e.g. superhydrophobicity).

03/2015 – 11/2019

Postdoctoral Researcher - RTDa

Politecnico di Torino, Department of Energy

The postdoc activity was funded by the projects "NANO-BRIDGE" (Heat and mass transport in NANO-structures by molecular dynamics, systematic model reduction, and non-equilibrium thermodynamics, PRIN-MIUR, 1 year), "NANOSTEP" (NANOfluid-based Solar absorption for Thermal Energy and water Purification, Fondazione CRT, 1 year), and by Politecnico di Torino (RTDa, 3 years).
Research activities focused on:

- Technical development of **solar energy absorbers** for efficient solar-to-heat conversion and/or water purification processes.
- Technical development of sorption **thermal storage devices**.
- Technical development of devices made by **additive manufacturing** techniques for enhanced heat transfer.
- Modelling mass transfer properties of water in nanoporous membranes for **energy-efficient desalination**.
- Modelling heat transfer properties of **polymer-based composite materials** filled by carbon nanostructures.
- Modelling heat and mass transfer properties of **colloidal** nanosuspensions.

07–08/2014

Visiting Research Fellow

Massachusetts Institute of Technology (MA, USA), Mechanical Engineering Department

The research stay at the Device Research Laboratory (Prof. Evelyn Wang and Dr. Tom Humplik, http://drl.mit.edu/) was part of the Ph.D. activities related to the water diffusion in nanoporous material for **water desalination** by reverse osmosis.

01–12/2013

Research Fellow

Houston Methodist Research Institute (TX, USA), Nanomedicine Department

The research stay was part of the Ph.D., and the main activity was the study of water physics in the proximity of **theranostic nanoparticles** (thermal ablation treatment and magnetic resonance imaging). The research was carried out in a multidisciplinary research group, under the supervision of Prof. Paolo Decuzzi (http://www.iit.it/en/people/paolo-decuzzi.html).

EDUCATION

03/2015

Ph.D. in Energy Engineering and Nanotechnology

Joint Doctorate: Politecnico di Milano, Politecnico di Torino and Politecnico di Bari

The Ph.D. degree comes with the "High Qualification Doctorate" certificate in Nanotechnology by Scuola Interpolitecnica di Dottorato. The main results are: (1) the general scaling law found for water diffusion under nanoconfined conditions, which has been published on **Nature Communications** and **Advanced Functional Materials**; (2) the original

understanding of the water transport through nanoporous membranes for desalination, which has been published on **Nature Communications**.

Thesis title: "*Heat and mass transfer of water at nanoscale solid-liquid interfaces*"
Supervisors: Prof. Pietro Asinari, Dr. Eliodoro Chiavazzo

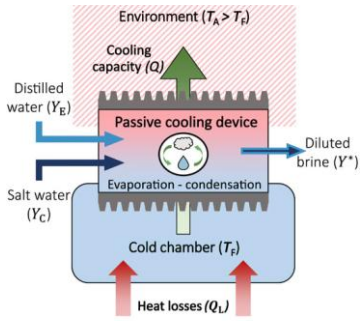
10/2011

POLITECNICO MILANO 1863

M.Sc. in Mechanical Engineering (110/110 and Honours)

Double Degree: Politecnico di Milano and Politecnico di Torino
Thesis title: *"Generalized thermodynamics description of complex biological systems"*
Supervisors: Prof. Pietro Asinari, Dr. Eliodoro Chiavazzo, Prof. Davide Ambrosi

SELECTED ACADEMIC RESEARCH

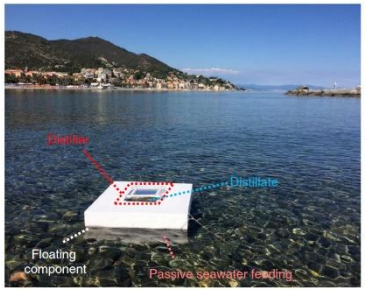


Sustainable cooling by passive processes

Implementation of low-cost technologies for **sustainable cooling** based on passive **evaporative and radiative processes**. Two solutions have been prototyped, modelled and tested: (1) multi-stage evaporative cooling driven by salinity gradient between aqueous solutions (in collaboration with Istituto Nazionale di Ricerca Metrologica – **INRiM**); (2) polymeric textiles with selective optical properties and enhanced capillarity, allowing radiative cooling and transpiration (in collaboration with Massachusetts Institute of Technology – **MIT**).

Main outcomes:

- M. Alberghini, M. Morciano, M. Fasano, F. Bertiglia, V. Fernicola, P. Asinari and E. Chiavazzo, Multistage and passive cooling process driven by salinity difference. **Science Advances 6**(11), eaax5015 (2020).
- M. Alberghini, S. Hong, …, M. Fasano and S.V. Boriskina, Sustainable polyethylene fabrics. Sustainable polyethylene fabrics with engineered moisture transport for passive cooling. **Nature Sustainability**, 4(8), 715-724 (2021).



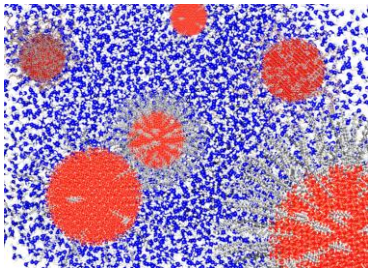
Floating solar distiller tested on the Ligurian Sea (Varazze, Italy)

Water treatment by sustainable thermal energy sources

Implementation of low-cost technologies for **sustainable water desalination and sanitation**. Several solutions have been **prototyped and tested**: (1) passive desalination by multi-stage membrane distillation, driven by solar or waste heat; (2) efficient solar steam generation; (3) thermal water sanitation.

Main outcomes:

- E. Chiavazzo, M. Morciano, F. Viglino, M. Fasano and P. Asinari, Passive solar high-yield seawater desalination by modular and low-cost distillation. **Nature Sustainability 1**(12), 763 (2018).
- M. Morciano*, M. Fasano*, L. Bergamasco, A. Albiero, M. Lo Curzio, P. Asinari and E. Chiavazzo, Sustainable freshwater production using passive membrane distillation and waste heat recovery from portable generator sets. **Applied Energy 258**, 114086 (2020). * *M. Morciano and M. Fasano share the first authorship*



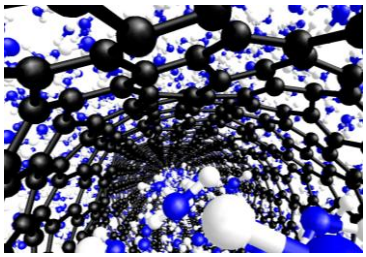
Atomistic simulation of a colloidal suspension of coated nanoparticles

Thermal-fluid properties of nanosuspensions for solar

Computational investigation of the effect of nanoparticles characteristics on properties of colloidal suspensions with energy (enhanced heat transfer) or biomedical (thermal ablation) applications. Part of the activity is developed with Prof. Fernando Bresme (**Imperial College London**).

Main outcomes:

- M.B. Bigdeli, M. Fasano, A. Cardellini, E. Chiavazzo and P. Asinari, A review on the heat and mass transfer phenomena in nanofluid coolants with special focus on automotive applications. **Renewable and Sustainable Energy Reviews 60**, 1615-1633 (2016).
- A.S. Tascini, J. Armstrong, E. Chiavazzo, M. Fasano, P. Asinari and F. Bresme, Thermal transport across nanoparticle-fluid interfaces: the interplay of interfacial curvature and nanoparticle-fluid interactions. Physical Chemistry Chemical Physics **19**, 3244-3253 (2017).



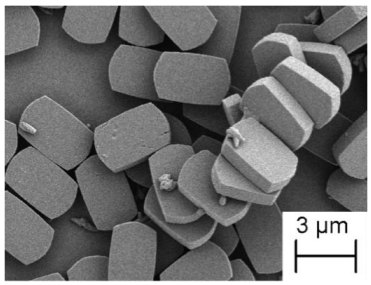
Simulated water molecules nanoconfined in a carbon nanotube

Water mass transfer at the nanoscale

Atomistic simulations, thermodynamic understanding, and scaling of water transport in several nanoconfined configurations. Modeling results are successfully compared to experimental evidence. Part of the activity is carried out in collaboration with Prof. Paolo Decuzzi (**Houston Methodist Research Institute**) and Prof. Serafim Kalliadasis (**Imperial College London**).

Main outcomes:

- E. Chiavazzo*, M. Fasano*, P. Asinari and P. Decuzzi, Scaling behaviour for the water transport in nanoconfined geometries. **Nature Communications 5**, 3565 (2014). ** E. Chiavazzo and M. Fasano share the first authorship*
- A. Gizzatov, …, M. Fasano, …, M. Ferrari, L.J. Wilson and P. Decuzzi, Hierarchically structured magnetic nanoconstructs with enhanced relaxivity and cooperative tumor accumulation. **Advanced Functional Materials 24**, 4584 (2014).
- M. Morciano, M. Fasano, …, P. Asinari and S. Kalliadasis, Nonequilibrium molecular dynamics simulations of nanoconfined fluids at solid-liquid interfaces. Journal of Chemical Physics **146**, 244507 (2017).



MFI zeolites tested for reverse osmosis desalination (MIT)

Nanoporous materials for water desalination

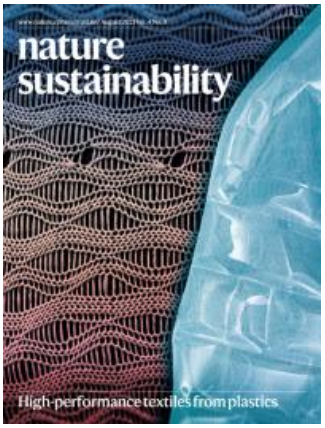
Numerical and experimental analysis of nanoporous materials for **energy-efficient water desalination** and molecular sieving. Modeling results allow to interpret the nanoscale physics observed in experiments and to suggest original configurations with enhanced membrane permeability. Part of the activity is developed in collaboration with Prof. Evelyn Wang (**Massachusetts Institute of Technology**, MITOR initiative).

Main outcomes:

- M. Fasano, T. Humplik, A. Bevilacqua, M. Tsapatsis, E. Chiavazzo, E.N. Wang and P. Asinari, Interplay between hydrophilicity and surface barriers on water transport in zeolite membranes. **Nature Communications 7**, 12762 (2016).
- M. Fasano, A. Bevilacqua, E. Chiavazzo, T. Humplik and P. Asinari, Mechanistic correlation between water infiltration and framework hydrophilicity in MFI zeolites. Scientific Reports **9**(1), 1 (2019).

AWARDS AND HONOURS

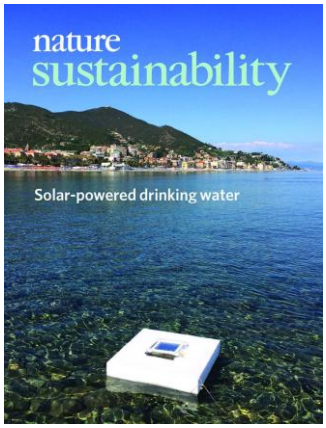
2021



Cover page on Nature Sustainability

One of the most relevant results of my research activities, namely the study of capillary and evaporative properties of sustainable fabrics made of polyethylene (March 2021), has received significant media recognition both nationally and internationally. The news was picked up by the BBC international edition, an interview with **Rai TGLeonardo**, the **World Economic Forum** and **MIT News**, among others. In addition, the article "Sustainable polyethylene fabrics with engineered moisture transport for passive cooling" published in the scientific journal Nature Sustainability earned the **cover page** of volume 4 (August 2021, see the side image). This article was also picked up by the prestigious journals Nature (Impact Factor: 49.9) and Nature Review Materials (Impact Factor: 66.3) at their respective "Research highlights" sections.

2019



Cover page on Nature Sustainability

The article “Passive solar high-yield seawater desalination by modular and low-cost distillation” was selected as the **cover story for the December issue of Nature Sustainability** journal (see the side image). In particular, one of the pictures that I took during the field experiments of the distillation device has been selected as cover image.
This article has been also highlighted by several national (e.g. https://www.lastampa.it/2018/12/19/scienza/il-dispositivo-che-depura-lacqua-salata-sfruttando-il-segreto-delle-mangrovie-xrscf6IMNiIAG6mZPEz5HJ/pagina.html) and international (e.g. https://www.nature.com/articles/s41893-018-0186-x/metrics) blogs and newspapers.

2017

ENI Award 2017 as the “**Young researcher of the year**” in the Energy sector (https://www.eni.com/static/it-IT/infografiche/eni-award-2019/index.html?lang=en).
The award ceremony was celebrated at Quirinale (Rome) in presence of the **President of the Italian Republic** (see on the left) and disseminated by the main Italian newspapers.

FUND RAISING

2024

Unit PI in the project "**M2DESCO: Computational Multi-Models Enabled Design of Safe & Sustainable Multi-Component High-Entropy Coatings**" by Horizon EU. The project has € 5,142,175 budget (EU funding to Politecnico di Torino: € 608,250) and 9 academic/industrial partners. M2DESCO project aims to design innovative high-entropy alloys by developing a set of design frameworks that integrate computational modelling, AI, and machine learning. These frameworks will enable the creation of next-generation, sustainable coatings, eliminating the need for toxic substances and critical metals. The project will shorten synthesis cycles, reduce waste, and improve EU modelling community.

2022

Coordinator and co-Principal Investigator of the project "**MELoDIZER - Sustainable membrane distillation for industrial water reuse and decentralised desalination approaching zero waste**" by Horizon EU. The project has **€ 9,680,207 budget** (EU funding to Politecnico di Torino: € 1,398,125) and 18 academic/industrial partners.
MEloDIZER implements high-performance membranes and modules in strategic applications of membrane distillation for water treatment. These parts are fabricated with a focus on feasible wide uptake and on sustainability, substituting harmful materials and protocols with >80% of benign solvents and relying on green chemistry principles. Two prototypes are demonstrated in industrial facilities (textile, beverage, chemical industries) to reuse wastewater (70-90%), thus reducing water footprint and approaching zero waste, as well as to recovery valuable nutrients as secondary raw materials from aquaculture wastewater. Two further prototypes are demonstrated as low-cost, ready-to-use, passive, autonomous, decentralised units, delivering drinking freshwater from seawater and other challenging water sources at community and family level. All prototypes are run with 90-100% sustainable energy from waste heat and/or solar energy. Quantitative, robust evaluations of market entry and environmental benefits act as input data for each innovation activity in MEloDIZER and to promote exploitation.

2022

ThalesAlenia Space
a Thales / Leonardo company

Coordinator and Principal Investigator of the project "**RECLS – Modelling of the energy and water purification performance of deep space technologies**" by ThalesAlenia Space.
RECLS aims at designing an energy-efficient water purification system for deep space applications, thanks to the use of lumped parameters modelling. The materials, cost and energy sustainability of the device are duly considered in the analysis.

2021

Unit PI in the project "**EuReComp: European recycling and circularity in large composite components**" by Horizon EU. The project has € 8,903,632 budget (EU funding to Politecnico di Torino: € 350,375) and 20 academic/industrial partners.
EUReCOMP aims to provide sustainable methods towards recycling and reuse of composite materials, coming from components used in various industries, such as aeronautics and wind energy. The main pathways to achieve circularity include: i) repairing, repurposing and redesigning parts from end-of-life large scale products and ii) recycling and reclamation of the materials used in such parts; thus, accomplishing reduction of waste and transformation to high-added value products. Disruptive solutions for sustainable composite recycling are studied with atomistic detail, e.g., supercritical water solvolysis.

2021

Unit PI in the project "**PaRaMetriC: Metrological framework for passive radiative cooling technologies**" by EURAMET funding program. The project has € 2,346,525 budget (EU funding to Politecnico di Torino: € 62,500) and 18 academic/industrial partners.
The international research group aims to study the processes and measurement tools for the characterization of optically selective

materials for energy-saving radiative cooling. This study is carried out through the development of concentrated parameter models of a radiative cooling system for industrial or residential air conditioning.

2019

Coordinator and Principal Investigator of the project "**Passive Solar Cooling via Engineered Optical and Evaporation Phenomena**" by MIT (MISTI).
The granted funds are employed for exploring the synergy between two passive refrigeration strategies – radiative and evaporative cooling. In this sense, the expertise from MIT and Politecnico di Torino groups, respectively, is fully complementary, paving the road to new original solutions for sustainable cooling.

2018

Participant and Work Package Leader for the project "**SMARTFAN: Smart by Design and Intelligent by Architecture for turbine blade fan and structural components systems**" by Horizon 2020. The project has € 7,989,601 budget (EU funding to Politecnico di Torino: € 300,968) and 18 academic/industrial partners.
The SMARTFAN project aims to study "smart" materials and product architectures, with the ability to interact with the surrounding environment and react to its stimuli. The composite materials used are based on carbon fibers, polymer matrices and nanoparticles with thermochromic, piezoelectric or electromagnetic properties.

2017

Participant and Work Package Leader for the project "**OYSTER: Open characterization and modelling environment to drive innovation in advanced nano-architectured and bio-inspired hard/soft interfaces**" by Horizon 2020. The project has € 3,999,752 budget (EU funding to Politecnico di Torino: € 249,800) and 15 academic/industrial partners.
The international research group aims to study the mechanism of adhesion between solids or between solids and liquids using experimental and numerical characterization techniques. These implement multi-scale models, ranging from atomistic to continuous level, with industrial applications in electronics, optics, biomedicine and mechanics.

2016

Co-Principal Investigator of a **Proof of Concept** grant funded by Politecnico di Torino to the best technology transfer projects in the energy field.

2015

Principal Investigator of the **Climate-KIC Accelerator Italy** seed grant funded by Climate-KIC (http://www.climate-kic.org/) to the best 12 technology transfer projects in the Cleantech sector in Italy.

LIST OF PUBLICATIONS (see Scopus)