

**Ph D in Materials for Sustainable Development**  
**Teaching Activity 2023/24**

**MATERIALS CHALLENGES IN CONCENTRATING SOLAR THERMAL RESEARCH**

Professor Luca Turchetti ([luca.turchetti@enea.it](mailto:luca.turchetti@enea.it))  
Professor Anna Chiara Tizzoni ([annachiara.tizzoni@enea.it](mailto:annachiara.tizzoni@enea.it))

Location:

**SEMINAR ROOM DEPARTMENT OF CHEMICAL SCIENCE AND TECHNOLOGIES**

**Calendar:**

7 May 2024, 10:00 -13:00  
8 May 2024, 10:00 -11:30  
20, 22 May 2024, 10:00 -13:00

**Syllabus**

Thanks to the availability of commercial thermal energy storage solutions that, in current installations, allow to operate at rated capacity for more than 17 h without solar resources, concentrating solar thermal (CST) technologies can provide a firm and dispatchable renewable energy supply for a wide range of applications like power generation, industrial or residential heating, or fuel production.

The CST industry is relatively young, and there is still much room for research to improve the techno-economic performance of the current technologies. In this respect, materials research can play a primary role, since the harsh operating conditions (e.g., very high temperatures, and corrosive environments) that characterize several key components of CST plants call for advanced solutions combining sustainability, durability, and cost-effectiveness with good mechanical, optical, chemical, and thermal performance.

This series of lectures will provide an overview of the status of CST technologies and an insight on some current research topics on materials research carried out in this field by ENEA - Italian National Agency for New Technologies, Energy and Sustainable Economic Development.

**List of Lectures:**

- **Part I: Overview of CST technologies**
  - **Introduction to CST technologies** Contents: development of the current CST industry, review of concentration technologies and respective fields of application, heat transfer fluids, thermal energy storage, review of current plant types, site selection criteria, overview of present market
  - **Thermal energy storage for CST plants: overview of the main commercial solutions and R&D concepts** Contents: Analysis of requirements for thermal storage for CST plants; review of commercial and advanced TES concepts; main issues and open challenges



- **Solar thermochemical hydrogen production** Contents: Overview of the main pathways to hydrogen production based on the use of solar heat; examples of applications in combination with CST plants
- **Part II: Materials challenges in CST**
  - **Development and characterization of molten salt mixtures as heat transfer fluids for CST applications.** Contents: Overview of molten salt mixtures; identification and measurement of relevant thermophysical and transport properties; thermal stability and corrosion issues; (semi)predictive methods for the determination of the properties of MS mixtures.
  - **Materials for high-temperature thermochemical energy storage.** Contents: Reacting solids for thermochemical energy storage (TCES); synthesis of CaO-based and mixed-oxides TCES materials; experimental; experimental characterization of relevant properties; performance assessment in lab-scale reactors.
  - **Perovskites as reactive materials for hydrogen production through thermochemical cycles.** Contents: General aspects on perovskites; experimental analysis of perovskites redox cycles; thermodynamics of non-stoichiometric perovskites redox reactions.

#### **About the teachers:**

##### **Luca TURCHETTI, PhD**

Luca Turchetti is research engineer at the Solar Thermal Energy and Smart Network Division of ENEA (Italian National Agency for New Technologies, Energy and Sustainable Economic Development) and adjunct professor at the University of Rome "La Sapienza". He is a chemical engineer and holds a PhD in Industrial Chemical Processes awarded by the University of Rome "La Sapienza".

He has 20 years' experience in fundamental and applied research in the field of renewable energy, with specific focus on concentrating solar thermal technologies, such as thermal energy storage systems and innovative chemical processes supplied with high-temperature solar heat. His activities range from process modeling and simulation to the development and testing of laboratory- and pilot-scale systems; furthermore, he served as coordinator of research unit in several Italian and European projects.

Since 2020, he sits as Italian delegate in the executive committee of SolarPACES, the technology collaboration programme of the International Energy Agency (IEA) devoted to solar power and chemical energy systems.

He has also carried out an extensive didactic activity as professor in graduate and undergraduate University courses, lecturer in joint industry-academia masters and industrial training courses, coordinator and lecturer in technical schools for professionals and PhD graduates; furthermore, he served as supervisor in numerous graduate and under-graduate theses and co-supervisor in PhD theses.

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##### **Anna Chiara TIZZONI, PhD**

Anna Chiara Tizzoni, graduated in Physics at University of Rome Sapienza, received his PhD in Material Sciences for Energy, Health, and the Environment at University of Rome Tor Vergata. Since 2019 she works in the in the Solar Energy and Smart Network Division in Rome (Casaccia Research Centre), dealing with the study, the development, and the characterization of materials for energy



storage and production. She is co-author of several peer reviewed papers and has been involved in National and European project.

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