# Paola Costamagna

Associate professor

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## Education and training

1992
### MS in Chemical Engineering
Fluid dynamic phenomena in fuel cells - 110/100 cum laude and honors
Università di Genova - Genova - IT

1997
### PhD in Chemical Engineering
Fluid dynamic and transport phenomena in monolithic electrochemical reactors. Application to solid oxide fuel cells.
Politecnico di Torino - Torino - IT

## Academic experience

2005 - ONGOING
### Associate professor
Università di Genova - Genova - IT
research and teaching

2001 - 2005
### Researcher
Università di Genova - Genova - IT
research and teaching

2000 - 2001
### Research associate
Università di Genova - Genova - IT
research and teaching

1999
### Research associate
Princeton University - Princeton - US
research

1997 - 1998
### POst-doctoral fellow
Università di Genova - Genova - AF
research and teaching

## Language skills

**English**
Proficient

**French**
Independent

## Research interests

My research is focused mainly on electrochemical reactors (namely, fuel cells) and their plants, with attention to the optimization of all those aspects which could improve the energy efficiency and the environmental compatibility of the reactor and eventually of the whole plant. The studies have been concentrated on solid oxide, molten carbonate and proton exchange membrane fuel cells (SOFC, MCFC and PEMFC respectively). I developed both experimental and theoretical activities, and all the levels of detail have been analyzed, from a microscopic scale (electrolyte and electrodes), up to the single cell and stack scale and then to the whole plant scale.

Currently, I am working on a model for novel infiltrated MIEC (Mixed Ionic-Electronic Conductor) electrodes for intermediate temperature SOFC (IT-SOFC) applications. We consider an LSCF (La1-xSrxCo1-yFeyO3-δ,) cathode formed of straight fibers, for example nanotubes, nanorods or nanofibers. Being LSCF a mixed ionic electronic conductor (MIEC), we consider that it features two separated charge conduction paths, one for electrons and one for oxygen-ions. Infiltrated dopant particles, adherent to the LSCF fibers, create contact points between the ionic and the electronic conductive paths, among which, otherwise, the charge transfer reaction would be negligible. Based on this picture of the doped LSCF electrode, a continuous model has been developed. Simulation results are compared to literature experimental data, demonstrating good agreement. In particular, the model captures very well the improvement of performance of the doped electrodes over the undoped ones, which can be five to ten fold or even more in some cases, making them good candidates for IT-SOFCs. An experimental activity on this topic is currently in progress, in collaboration with the group of Prof. Peter Holtappels at the Denmark Technical University (DTU).

In addition, a research activity is in progress, focused on SOFC and their systems. Despite these plants exhibit high energy conversion efficiency and environmental compatibility, however, they still suffer from a low reliability (of both the fuel cells and the whole system) and a limited lifetime. In this framework, we are developing a Fault Detection and Isolation (FDI) tool, designed to be the core of an AEM (Abnormal Event Management) device, whose scope is early detection, diagnosis and correction of faults in an industrial process. AEM aims at reducing productivity losses and risk of accident, which can be achieved if AEM is performed when the plant is still operating in a controllable region. A wide number of FDI methods have been proposed in the literature and applied to a variety of systems in the field of chemical or mechanical engineering, but they have rarely been applied to SOFC systems until present. In our case we employ our models, validated in a wide number of operating conditions, to perform fault

implantation, i.e. the simulation of possible faults occurring in the system, and in particular in the SOFC stack. The results are collected in maps which show the behavior of some monitored system variables in presence of a fault. These maps are in the format required by, and thus they provide the basis for, the development of an FDI tool based on pattern recognition. Pattern recognition is a discipline that has enabled the development of FDI techniques, but it has never been applied to SOFC systems until present. Our pattern recognition FDI tool is now trained through our fault maps data in order to be able to detect and identify possible failures arising in the SOFC system under study. In future applications to real operation of the SOFC experimental systems, the validated model and the pattern recognition FDI tool will be used jointly as a part of the AEM device for detection and isolation of failures.

## Grants

2002 - 2009

**Modelling of Solid Oxide Fuel Cells (SOFCs) experimental validation and optimisation studies**

Rolls-Royce FUel Cell Systems Ltd. - GB

469.000 Euro - Pricipal investigator

## Editorial activity

I have been serving as a reviewer for a number of international journals, including the Journal of Applied Electrochemistry, Journal of Power Sources, Journal of Fluids Engineering, Journal of Engineering for Gas Turbines and Power, Electrochimica Acta, Industrial and Engineering Chemistry Research, Journal of Membrane Science, Chemical Engineering Science, Journal of the Electrochemical Society. I have been recognized as Outstanding Reviewer by the Elsevier Journals: Journal of Cleaner Production, Journal of Power Sources, Electrochimica Acta, International Journal of Hydrogen Energy. Since 2003, I have been member of the Editorial Board of the Journal of Power Sources (Elsevier, IF2017: 6.945). Since 2017, I have been member of the Editorial Board of the journal Energy Conversion and Management (Elsevier, IF2017: 6.377).

I was Guest Editor of the Special Issue of the International Scientific Journal MDPI Energies 'Reacting Transport Phenomena in Electrochemical Cells', 2015/2016.

I have participated in the technical-scientific committee of several International Conferences (recently, ICMS 2015, ICMS 2016, EU SOFC & SOE Forum 2016 and 2018).

## Assigments abroad

18 January– 18 December 1999

**Research Associate** at the*Department of Chemistry* of **Princeton University**, NJ, USA. Research topic: *Experimental Study of a New Composite Membrane for Fuel Cell Operation at Temperatures above 100°C.* Responsible: Prof. Andrew B. Bocarsly e Dr. Supramaniam Srinivasan.