

# Preface

Professor Maria Turco is Associated Professor at the Faculty of Engineering of University “Federico II” of Napoli, where she teaches courses in “Industrial Chemistry,” “Traditional and Innovative Fuels and Fuel Cells,” and “Catalysis”. Professor Maria Turco carried out research activity, mainly in the field of the technologies for the production of energy with low environmental impact, such as catalytic processes for removal of gaseous pollutants and processes for hydrogen production. A large part of her recent activity is devoted to the study of fuel cells for mobile or stationary applications.

Dr. Luca Micoli is a Ph.D. Chemical Engineer and researcher at the Department of Chemical, Materials and Production Engineering of University “Federico II” of Naples. His research activities are focused on fuel cells for different applications, such as portable and stationary power generation, and on methodologies for the clean-up stage.

Dr. Angelo Ausiello is a Ph.D. student in Chemical Engineering at the University of Naples “Federico II”. His research activities include the development of energy production systems based on fuel cells fueled by biogas produced from the anaerobic digestion of different kinds of biomass.

The interest in fuel cells (FCs) technology is growing continuously, since they have high potential of applications for many reasons such as emission-free energy supply, high efficiency, wide range of power generation from a few watts to some megawatts, and the possibility to be fed with different fuels including biogas. These and many other advantages have encouraged academic and industrial researchers worldwide to improve performances and the cost-effectiveness of fuel cells. Nowadays, the considerable level of technological readiness that has been reached finally allows to expect that fuel cells will penetrate into a large market.

The authors of this book are of the opinion that the FC technology has great potential and that it can play a key role in adapting the worldwide energy supply systems toward efficiencies and emission levels allowing a long-term stable and sustainable development for the world economy and environment.

Nevertheless, the authors consider that efforts on improving performances FCs are not enough to enter the market successfully, because the quality and the purity of the fuels, in particular biogas, need specific attention due to the presence of impurities or undesirable compounds in the fuels that can damage the components of a fuel cell (electrodes and electrolyte) and reduce the overall efficiency.

In the field of stationary power production high temperature fuel cells (MCFC and SOFC) are emerging as a promising alternative to combustion heat engines for the production of electrical power and cogeneration, and the possibility of feeding biogas as alternative fuel increases the interest for the evident environmental advantages. The use of biogas as fuel for FCs is an important task in the development of technologies for production of energy from renewable sources and is largely treated in the literature. At the same time gas purification processes based on adsorption on microporous materials are widely studied in the literature. This book reviews in a comprehensive way the main aspects regarding the purification procedures of biogas for fuelling MCFCs or SOFCs.

In Chap. 1 different processes of biogas production (fermentation, digestion, etc.) are described evidencing the dependence of the gas composition and content of noxious compounds on the specific process and on the source of biomass. Attention is focused on the different types of compounds that can be harmful for high temperature fuel cells and their reformer systems such as sulfur compounds inorganic and organic) and siloxanes.

Chapter 2 summarizes the operating principles of the fuel cells in order to provide an understanding of the basic operations.

Chapter 3 is an overview of the main challenges that such new technology meets shifting from a well-established niche market to the civilian one in a commercialization process.

In Chap. 4 the technologies proposed in the literature for removal of noxious substances are reviewed with particular attention to adsorption processes. The adsorbent materials that appear the most probable candidates for this application (based on zeolites and activated carbons) are described with emphasis on the methodologies aimed to improve the adsorption properties. The regeneration of the materials is also taken into account.

In Chaps. 5–7 the effects of sulfur compounds and siloxanes on performances of MCFC and SOFC are described. The mechanisms of interaction of these compounds with the components of FCs (electrodes and electrolyte) are also treated.

Treatment of Biogas for Feeding High Temperature Fuel  
Cells

Removal of Harmful Compounds by Adsorption  
Processes

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