

Environmental Challenges and Greenhouse Gas Control for Fossil Fuel Utilization in the 21st Century

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Preface

As we are moving ahead into the 21st century, our hunger for cost-effective and environmentally friendly energy continues to grow. The Energy Information Administration of US has forecasted that only in the first two decades of the 21st century, our energy demand will increase by 60% compared to the levels at the end of the 20th century. Fossil fuels have been traditionally the major primary energy sources worldwide, and their role is expected to continue growing for the forecasted period, due to their inherent cost competitiveness compared to non-fossil fuel energy sources. However, the current fossil energy scenario is undergoing significant transformations, especially to accommodate increasingly stringent environmental challenges of contaminants like sulfur dioxide, nitrogen oxides or mercury, while still providing affordable energy. Furthermore, traditional fossil fuel utilization is inherently plagued with greenhouse gas emissions from combustion, especially carbon dioxide from stationary sources as well as from mobile sources. Should worldwide government policies dictate a reduction of greenhouse gas emissions, such as proposed by the Kyoto Protocol and the implementation of carbon taxes, fossil fuels would lose their significant competitive appeal in favor of nuclear energy and renewable energy sources. However, the current non-fossil fuel energy share of the worldwide energy market is merely below 15%, and therefore, it is more likely that fossil fuel energy producers would adapt to the new requirements by developing and implementing emission control technologies, and emission trades among other strategies. Under this energy scenario, where the elimination of fossil fuels from our energy portfolio would irrefutably lead to an energy famine, researchers from all over the world in academia, government and industry

are developing new technologies to ensure a continuing supply of affordable and clean energy in the 21st century.

This book is based on two symposia that were held at the American Chemical Society National Meeting in San Diego, California, USA, in April 2001, where strategies for the utilization of fossil fuels in the 21st century were presented. The symposia titled "Greenhouse Gas Control and Utilization" and "Environmental Challenges for Fossil Fuel Utilization" were sponsored by the Division of Fuel Chemistry, and the latter was also co-sponsored by the Division of Environmental Chemistry. International representatives from numerous countries around the world, including USA, Canada, China, Australia, Japan, Italy, Belgium, Netherlands, Spain, India, France and South Korea, presented oral papers and posters that covered recent developments for the continuous utilization of fossil fuels, especially those related to environmental challenges and greenhouse gas control.

This book contains thirty peer-reviewed chapters that will provide the readers with updated research progress in the field of environmental chemical research related to fossil fuel utilization. Furthermore, its international flavor will ensure that a worldwide broad cross-section of scientific and engineering research is covered throughout the book. The book is logically divided into the following six sections: (1) *Pollutant Emissions* gives an overview of multiple emission control strategies including sulfur dioxide, nitrogen oxides, carbon dioxide, and mercury, as well as particulate matter and polyaromatic hydrocarbons; (2) *Carbon Sequestration* describes this option for mitigating global warming and presents recent developments for carbon storage by mineral carbonates, ocean fertilization, biomimetic systems and sorbents; (3) *Greenhouse Gas Emission Control* describes strategies to reduce greenhouse gases from power plants, oil/gas fired furnaces and engine exhausts; (4) *Utilization of CO₂ for Synthesis Gas Production* comprises chapters that cover recent developments on reforming of natural gas and methane, as well as catalyst characterization; (5) *Utilization of CO₂ for Chemical Synthesis* presents research developments to synthesize methanol, formic acid, styrene and dialkyl carbonates using CO₂; and (6) *Combustion Byproducts* closes the book by describing strategies that are needed for the management of byproducts associated with energy production and fossil fuels including characterization, separation, treatment and utilization.

As the editors, we hope that the reader encounters in this book some of the answers that will help fossil fuels to continue to thrive as an environmentally friendly energy source well into the 21st century.

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