

Advanced Structured Materials

Volume 76

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Novel Bismuth- Oxyhalide-Based Materials and Their Applications

 Springer

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ISSN 1869-8433

ISSN 1869-8441 (electronic)

Advanced Structured Materials

ISBN 978-81-322-3737-2

ISBN 978-81-322-3739-6 (eBook)

DOI 10.1007/978-81-322-3739-6

Library of Congress Control Number: 2017940815

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Printed on acid-free paper

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The registered company is Springer (India) Pvt. Ltd.

The registered company address is: 7th Floor, Vijaya Building, 17 Barakhamba Road, New Delhi 110 001, India

Preface

Energy and water are the two commodities that the modern world is running short of due to over population, over consumption, and vast industrialization and all the major world confrontations were and will be for controlling and manipulating these precious natural resources. Water is the foundation of life and more than 70% of planet earth is covered with water, but quite ironically, nearly 1.2 billion people on earth do not have access to clean drinking water. The rapid industrialization and reckless human activities wreak havoc on the precious water bodies by dumping alarming amount of organic, inorganic, and biological pollutants into it. Over the past few years, a variety of strategies have been investigated to develop efficient and pollution free technologies for the demineralization of highly toxic water pollutants to nontoxic products for waste water treatment. Photocatalysis has been emerged as one of the most promising technologies as it embodies more economical and green way to demineralize pollutants by using the energy from sunlight or artificial light sources. Photocatalytic process has a great potential for the removal of organic pollutants (dyes, phenolic compounds, pesticides, and herbicides), heavy metals, and other toxic pathogens (bacteria, fungus candida) from water. In addition photocatalysis can be applied for solar energy harvesting based on photovoltaic principle, especially in dye sensitized solar cells.

Ever since, Fujishima and Honda reported water splitting using TiO_2 electrode, many pure, doped, and composite variants of TiO_2 have been synthesized and used for various photocatalytic and solar energy applications due to its many positive attributes like low cost, physical and chemical stability, and high efficiency. However, one of the major constraints of TiO_2 for any photocatalytic application is its wide band gap energy, which limits its activity in the visible spectral region and hence it cannot be a good photocatalyst under solar radiation. Many pure, doped, and composite catalysts of CdS , SnO_2 , WO_3 , SiO_2 , ZnO , Nb_2O_3 , and Fe_2O_3 have been synthesized and used for various applications under solar radiation. In recent days a new breed of photocatalysts, bismuth oxyhalides have attracted considerable interest due to their efficient photocatalytic activity, high stability, low cost, and other properties like magnetic separation after use in water. These efforts have been

focused on those bismuth oxyhalide (BiOX, X= Cl, Br, I) based photocatalysts which are highly efficient, cheap, and could absorb in the visible region.

In this book, we have focused on recent development on various methods of synthesis of BIOX, their morphological and optical characterizations, different variants of doped and composites of BiOCl, BiOBr, BiOI, and their use in the photocatalytic waste water treatment, secondary batteries, gas sensors, and solar cells. Also this book touches upon the future prospect of these materials, in terms of synthesis, multidimensional shape dependence, and the hetero junctions of these materials for various photocatalytic and other applications. BiOX is considered to be very promising photocatalyst due to its utility of visible light as an excitation source and thus the use of solar radiations for future field applications for waste water treatment and solar energy harvesting.

The authors would like to thank the Deanship of Scientific Research, King Fahd University of Petroleum and Minerals in supporting this book project under project # IN141024. The authors would like to thank Mr Praveen Kumar from Springer for his patience and encouragement and Mr. Tanweer Alam from KFUPM who has worked on the formatting of the book. The authors are indebted to many people who have contributed to the improvement of this book by pointing to the errors and possible revisions. We thank many authors and publishers who were gracious enough to grant permission to use the figures from their works. The international Conference on Water, Environment, Energy and Society authors will appreciate any future cooperation of readers for improving this book.

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Acknowledgements

The authors would like to acknowledge the financial support provided by the Deanship of Scientific Research at King Fahd University of Petroleum and Minerals (KFUPM) for funding this book writing grant through project number IN141024. The authors are also grateful for the support received from the Department of Physics at KFUPM and in particular all the members and students working in the Laser Research Group of Physics Department.

The authors would like to thank Mr. Praveen Kumar from Springer Nature for his patience and encouragement. The authors would also like to thank Mr. Tanweer Alam from KFUPM for his support in the formatting of the book. We thank many authors and publishers who were gracious enough to grant permission to use figures and illustrations from their works. The authors are indebted to many people who have contributed to the improvement of this book by pointing to the errors and possible revisions.

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