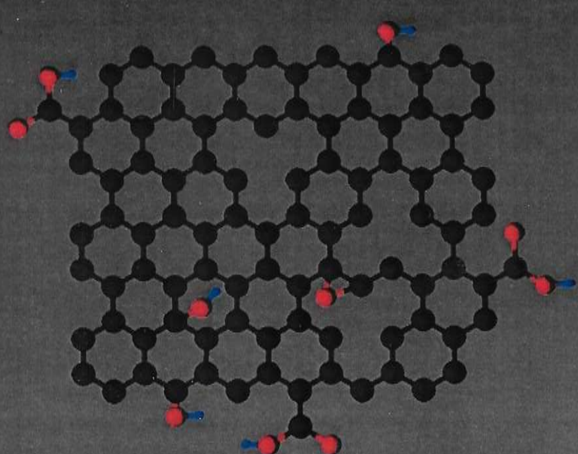
Comprehensive Study in Recent Applications of Water Splitting Based on Modified Graphene Oxide



Mohammed Fathi Alsultan

Enas mohammed Hazim

Assim Adil Sabah

Comprehensive Study in Recent Applications of Water Splitting Based on Modified Graphene Oxide

Mohammed Fathi Alsultan

Enas mohammed Hazim

Assim Adil Sabah

Table of contents

Tables of Figures

Table

Acknowledgment

This book has been analysed scientifically and thoroughly over 200 recent publications that highlighted water splitting based on reduced graphene oxide as renewable energy. We thank prof. Gerhard Swiggers from Wollongong University who provide us with most of these references and highlighted the interesting results of them. We thank University of Mosul that supported us over the last few months and provide us with all logistic facilities.

Authors

Mohammed Fathi Alsultan

- Bachelor in Science (B.S.) Chemistry University of Mosul/Iraq in 2001
- Master in Education (M.S.E) CHEMISTRY University of Mosul/Iraq in 2006
- Doctor of Philosophy (Ph.D.) Chemistry University of Wollongong / Australia in 2019
- Chemistry Lecture at University of Mosul basic education collage science 2007.
- Inorganic, Organic and Biochemistry since 2007 till now. More than 12 publication since 2016 in different international Journal.
- Email mohamadfkaleel@uomosul.edu.iq

Enas Hazim Mohammed

- Bachelor in Science (B.S.) Chemistry University of Mosul/Iraq in 1996
- Master in Education (M.S.i) CHEMISTRY University of Mosul/Iraq in 2005
- Doctor of Philosophy (Ph.D.) Department of Chemistry/ College of Science / University of Mosul/ Iraq 2010
- Chemistry lecture at University of Mosul basic education collage science since 2010.
- Lecture asst. at University of Mosul pharmacy collage (1997-2010)
- Lecture at University of Mosul basic education collage (2010-till present) Email: enashazim@uomosul.edu.iq

Assim Adil Sabah

- Bachelor in Science (B.S.) Chemistry University of Mosul/Iraq in 2005
- Master in Education (M.S.i) CHEMISTRY University of Mosul/Iraq in 2007
- Doctor of Philosophy (Ph.D.) Department of Chemistry/ College of Science / University of Mosul/ Iraq 2011.
- Chemistry Asst. Prof. at University of Mosul basic education collage science 2017.
- The editor of basic education journal (2017,2018). - The head of science dept. (2018-present).
- Email: assimsabah@uomosul.edu.iq

Summary

Currently, alternative energy being the most attractive technology demands around the world, due to an increase consumption of fossil oil. In contrast, fossil oil itself is depleting source of energy causes high amount of CO_2 emissions. Which leads to damage environments as a results of greenhouse phenomenon. Renewable energy is other term of alternative energy includes of exploiting natural power that come from sun, wind, geothermal heat, and nuclear energy. Water splitting is another type of renewable clean energy. In the last decades thousands of studies have focused on this sort of energy. This is because water splitting is cheap, environment friendly, could has high efficiency with long term of durability. In this book we highlighted the actual roles of reduced graphene oxide (rGO) in water splitting system. Over of two hundred references have analyzed and discussed thoroughly. Firstly in the introduction explained the water system principles and rGO chemical and physical properties.Then we addressed the roles of rGO in water splitting system. We concluded that rGO can play as photocatalyst, electron transfer channel, as cocatalyst, as redox mediator, dye-sensitized solar cell (DSSC).

1.1 Introduction

In 2008, the total energy consumption was estimated to be about 17 terawatts and it has been predicted to be double by 2050 and triple by 2100. Currently, 80 % of world's total energy consumption depends on fossil fuel which includes oil, natural gas and coal. Fossil fuel is depleting source of energy and the burning of it causes CO_2 emission which directly affects the change in climatic conditions. Thus, it is a necessity now to find a new alternative source for energy to reduce the dependence on fossil fuel and this could be achieved by other sources of energy such as biomass, nuclear, wind, geothermal energy and solar cell. Among them, it appears that, solar cell is the best choice. This is because each of the other resources has negative impacts either on the environment or in utilizing them. For example, biomass causes CO_2 emission; nuclear power has radioactive waste which has longer half-lives and there are always safety concerns associated with it (e.g., Chernobyl and Fukushima nuclear incidents) and finally when it comes to wind and geothermal energy sources, both have low efficiency and high cost of production[1].

Solar cell is a promising alternative technology because it is clean and green energy and it is able to alleviate energy crisis and environmental pollution. Many research papers and review articles are dedicated to this topic over the past few years. It is now known that solar energy that is received on the Earth's surface could meets the current and future human energy demand[2-4]. For example, when the sun light hits our planet for one hour it is equivalent to the total amount of energy that is consumed by all human activities in an year. It is anticipated that solar energy conversion system is estimated to contribute around 5% of global electricity consumption by 2030, and 11% by 2050[5]. This also means that avoiding 2.3 gigatonnes (Gt) of CO_2 emissions collectors through employing the sun's thermal energy and solar driven water-splitting (also known as artificial photosynthesis)[8-9]

In natural photosynthesis, sun, water and light are those needed for the plants to capture and convert sunlight into carbohydrates ($C_xH_{2x}O_x$) and other organic molecules which make up living organisms (biomass) and the food that we eat. The cycle of the natural photosynthetic activity has been in these plants from millions of years ago. It could be suggested that the origin of coal, which is the major form of fossil oil, is the plant itself after exposed to high temperature and pressure. Fig 1 illustrates the principles of energy flow in biology[9].

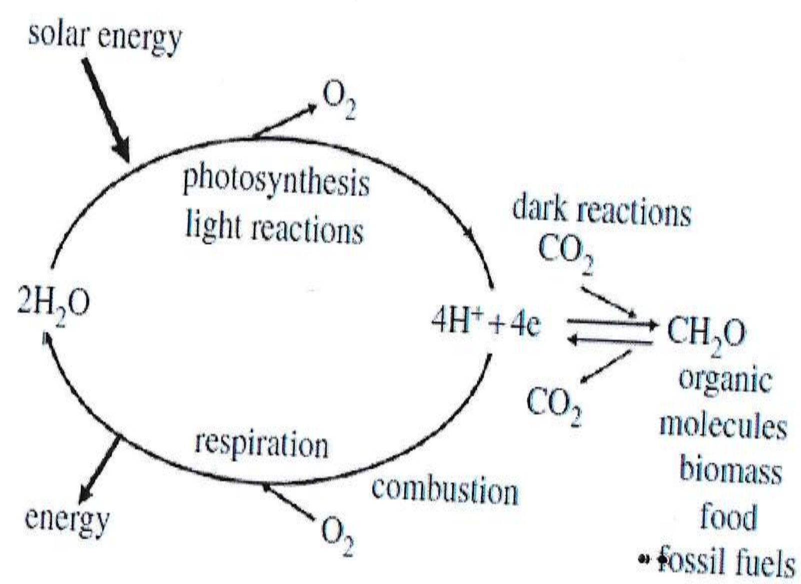


Figure 1 Diagrammatic representation of the water splitting during natural photosynthesis and the conversion of energy from sun into carbohydrate and variety of living materials [9].

Mohammed Fathi Alsultan

- *Bachelor in Science (B.S.) Chemistry University of Mosul/Iraq in 2001*
- *Master in Education (M.S.E) CHEMISTRY University of Mosul/Iraq in 2006*
- *Doctor of Philosophy (Ph.D.) Chemistry University of Wollongong / Australia in 2019*
- *Chemistry Lecture at University of Mosul basic education collage science 2007*
- *Inorganic, Organic and Biochemistry since 2007 till now. More than 12 publication since 2016 in different international Journal.*

Enas Hazim Mohammed

- *Bachelor in Science (B.S.) Chemistry University of Mosul/ Iraq in 1996*
- *Master in Education (M.S.i) CHEMISTRY University of Mosul/ Iraq in 2005*
- *Doctor of Philosophy (Ph.D.) Dept. of Chemistry/ College of Science / University of Mosul/ Iraq 2010*
- *Chemistry lecture at University of Mosul basic education collage science since 2010.*
- *Lecture Asst. at University of Mosul pharmacy collage (1997 - 2010)*
- *Lecture at University of Mosul basic education collage (2010-till present)*

Assim Adil Sabah

- *Bachelor in Science (B.S.) Chemistry University of Mosul/ Iraq in 2005*
- *Master in Education (M.S.i) CHEMISTRY University of Mosul/Iraq in 2007*
- *Doctor of Philosophy (Ph.D.) Department of Chemistry/ College of Science / University of Mosul/ Iraq 2011.*
- *Chemistry Asst. Prof. at University of Mosul basic education collage science 2017.*
- *The editor of basic education journal (2017,2018).*
- *The head of science dept. (2018-present).*

ISBN 9789922970684

9 789922 970684