FOREWORD

What is the aim of this book ?

For more than two centuries, we have had access to cheap, abundant, energy through coal, then through petroleum, and for long the only concern about the use of fossil energies was the pollution they induced and the fact that they would come to an end. In 'The Limits of Growth', report from the Club of Rome written in 1972, where the future challenges of mankind for the next centuries were addressed in detail, although the exponential increase of CO_2 concentration in the Earth's atmosphere was discussed, the potential effects on the planet climate of the human activity were just very briefly mentioned. The effect of human activity on Earth's global climate became a public issue only in the late 1980s, leading to the creation of the Intergovernmental Panel on Climate Change (IPCC). It became clearer and clearer since that one of the major challenges humanity has to face at short term is the progressive global warming of the planet induced by the increase of CO_2 in the atmosphere and its potential devastating consequences. Curiously, the relationship between CO_2 concentration and the temperatures at the surface of the planet has been addressed as soon as at the end of the 19th century by Arrhenius, in a quite detailed way, but it took nearly a century for the drift of mean temperature to become clear enough to be widely recognized. If nowadays, still a few voices contest the global warming, every year the measured planet temperatures confirm it as an evidence.

We presently face the absolute constraint of limiting the amount of CO_2 we emit in the atmosphere, and still a sizeable fraction of the human population has no or limited access to energy. The most optimistic estimations predict mankind to need about 30 TW per year in 2050, ie, twice more as we use now. In the present state of technology, the only way to achieve such an energy production without giving rise to a major climatic catastrophe is to learn how to use solar energy. The solar energy reaching the surface of the Earth is virtually unlimited as compared to human needs for energy. Thanks to photovoltaics we are able to transform it into electricity with increasing yields; however, we are not able yet to store this electricity into a stable form with high efficiency. Plants and more generally photosynthetic organisms have transformed directly solar energy into biomass for billion years,

and they store every year about twice what mankind will need in 2050. Among the most promising approaches to solve the forthcoming energy crisis, one is to develop devices which would, as photosynthetic organisms do, directly transform the solar energy into fuels. This is what is called 'artificial photosynthesis'.

Artificial photosynthesis can be achieved in a number of ways, from improving natural photosynthesis to solid-state approaches, covers a wide range of scientific fields involves theoretical as well as experimental work. The aim of this book is to summarize the different aspects of the artificial photosynthesis field, which, I strongly believe, will become one of the essential keys for the future of energy.