Acceptance speech
21 de septiembre de 2021

Michael Grätzel, awardee in the Basic Sciences category (13th edition)

Members of the Presidency, Authorities, Distinguished Guests,

On the evening of February 22, 2021, I was deeply moved when I received a phone call from Nobel laureate Professor Theodor Hänsch, the President of the selection committee of the BBVA Foundation Frontiers of Knowledge awards. He conveyed to me the excellent news that I had been selected to receive this year's BBVA Foundation Frontiers of Knowledge Award in Fundamental Sciences together with my colleague Paul Alivisatos.

I would like to thank Professor Hänsch and the other members of the selection committee for awarding me this prestigious prize. It is an enormous pleasure and high honor for me to be here in Bilbao to receive this distinguished award, which is highly acclaimed around the world because of its impressive credentials, in particular the outstanding merits of its previous recipients.

I accept the BBVA Frontiers of Knowledge Award in Basic Sciences with gratitude and wish to express my sincere congratulations to my fellow laureates.

Perhaps the greatest challenge for our global society is to discover ways to replace the slowly, but inevitably vanishing fossil fuel supplies by renewable resources, while avoiding the negative impact of the currently used energy systems on the climate, the environment and health.

The quality of human life depends to a large extend on the availability of clean energy sources. The worldwide power consumption is expected to double in the next three decades due to the increase in world population and the rising demand of energy needs in developing countries. This demand implies enhanced depletion of fossil fuel reserves accompanied by further aggravation of the environmental pollution and by acceleration of climate change. Together these two issues threaten to create a planetary emergency of gigantic dimensions.

Solar energy is expected to play a crucial role as a future energy source. The sun provides

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approximately 120'000 terawatts to the earth surface amounting to about six thousand times the present rate of the world's energy consumption. However capturing solar energy and converting it to electricity or to chemical fuels, such as hydrogen, at low cost and using abundantly available raw materials remains a huge challenge.

Fundamental science is expected to provide pivotal contributions to identify environmentally friendly solutions to this energy problem. The recent Sky scenario established by the Shell Corporation concludes that the photovoltaic production of electricity must increase 200 times over the next 50 years to meet the commitments of the Paris climate agreement and to stem the rise in global temperature within the limit of 2 °C.

My approach to harvesting solar energy and for converting it to electricity and chemical fuels was inspired by natural photosynthesis, i.e the process by which plants capture sunlight to drive the thermodynamically uphill conversion of carbon dioxide to sugar.

The solar cells that emerged from our extensive curiosity-driven fundamental research use a pigment to harvest sunlight mimicking the action of chlorophyll in the green leaf. Absorption of sunlight by the pigment generates electrons that are transferred to a semiconductor such as titanium dioxide.. Our key contribution has been to arrange the titanium dioxide in a three dimensional array of nanoparticles, instead of using it in the form of plates, like conventional silicon cells.

Each nanoparticle of titanium dioxide is coated with the pigment which dramatically enhances the light harvesting efficiency of the solar cell increasing its power conversion efficiency over 1000 times compared to that of a flat TiO2 plate. Our invention of the 3 dimensional nanocrystalline junctions constituted a new paradigm in photovoltaics and opened up a wide and very active field of research, which until now has produced over 25'000 publications in refereed scientific journals.

The advantages of these cells are multiple: abundant raw materials, a cheap manufacturing process, transparency, flexibility, and the ability to obtain electricity from ambient light. Our discovery has given rise to thousands of patents proving the vigor of its industrial development, which has led to a large number of commercial applications.

Recently our research engendered a second revolution in photovoltaics prompting the advent of perovskite solar cells. Progress in this research area has been amazing since the inception of this youngest member of photovoltaics some 10 years ago. Thelr power conversion efficiency increased from 3 to over 25 % during this time period stunning the photovoltaic community.

I take this opportunity to express my deepest gratitude to my coworkers and colleagues for their

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strong support as well as for the key contributions they have made to the advancement of our research. The BBVA award honors all of them as much as it honors me.

Thanks are also due to the public institutions and industrial companies that supported our research over several decades, in particular the Ecole Polytechnique Fédérale de Lausanne. I was very fortunate to be supported by my loving family including my wife and fellow research scientist, Carole, my 3 children Chauncey, Aimie and Liliane and my 4 grandchildren. Last but not least I would like to once again express my sincere gratitude to the BBVA foundation for conferring to me the prestigious Frontiers of Knowledge Award in Basic Science.