



UNIVERSITY OF MINNESOTA
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Department of Chemistry Kolthoff Lectureship in Chemistry

February 6-8, 2012

Professor Michael Graetzel

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Faculty Hosts: Philippe Buhlmann & Aaron Massari

Professor Michael Graetzel pioneered research on energy and electron transfer reactions in mesoscopic-materials and their application in solar energy conversion systems, optoelectronic devices and lithium ion batteries. He discovered a new type of solar cell based on dye sensitized nanocrystalline semiconductor oxide particles.



He is the author of more than 800 peer-reviewed publications and two books, and is the inventor of more than 50 patents. He has received prestigious awards, including the Balzan Prize, the Galvani Medal, the Faraday Medal, the Harvey Prize, the Gerischer Award, the Dutch Havinga Award and Medal, the International Prize of the Japanese Society of Coordination Chemistry, the ENI-Italgas Energy-Prize and the year 2000 European Grand Prix of Innovation. He was selected by the Scientific American as one of the 50 top researchers in the world.

He received a doctor's degree in natural science from the Technical University Berlin and honorary doctors degrees from the Universities of Hasselt, Delft, Uppsala and Turin. He has been the Mary Upton Visiting Professor at Cornell University and a Distinguished Visiting Professor at the National University of Singapore. He was an invited professor at the University of Berkeley, the Ecole Nationale de Chachan (Paris) and Delft University of Technology. In 2009, he was named Distinguished Honorary Professor by the Chinese Academy of Science (Changchun) and the Huazhong University of Science and Technology. He is a member of the Swiss Chemical Society as well as of the European Academy of Science, a Fellow of the Royal Society of Chemistry and was elected honorary member of the Société Vaudoise des Sciences Naturelles.

Lecture 1: *The Advent of Mesoscopic Solar Cells* 3:45 p.m. Monday, February 6, 100 Smith Hall

A reception for Professor Graetzel will be conducted in 117/119 Smith Hall immediately following this lecture. All are welcome to attend.

Learning from the concepts used by green plants we have developed nanostructured photovoltaic devices whose overall efficiency for solar energy conversion to electricity presently attains 12-13%. Following its inception in 1991, the dye sensitized mesoscopic solar cells (DSSC) was the first device to use a three-dimensional interpenetrating network (bulk) junction for solar light energy harvesting and conversion. The role of the sensitizer or semiconductor quantum dot is to absorb light and generate positive and negative electric charges, which are collected by appropriate charge transport materials. The latest progress in the design and preparation of new sensitizers and redox electrolytes has allowed attaining unprecedented photovoltaic performance. Impressive stability both under long-term light soaking and high temperature stress has been achieved, fostering first industrial applications. Commercial development focuses on light-weight flexible cells and electricity producing glass panel (Figure 1). The low cost and ease of production of the new cell will benefit large-scale applications. These systems will promote the acceptance of renewable energy technologies, not least by setting new standards of convenience and economy.



Figure 1. Left: DSSC glass panels employing green porphyrin sensitizer [1] for electric power generation from sunlight. Right: flexible DSSC mounted on backpack as portable source for electric power (courtesy G24Innovation www.g24i.com).

Izaak Maurits Kolthoff was born on February 11, 1894, in Almelo, Holland. He died on March 4, 1993, in St. Paul, Minnesota. In 1911, he entered the University of Utrecht, Holland. He published his first paper on acid titrations in 1915. On the basis of his world-renowned reputation, he was invited to join the faculty of the University of Minnesota's Department of Chemistry in 1927. By the time of his retirement from the University in 1962, he had published approximately 800 papers. He continued to publish approximately 150 more papers until his health failed. His research, covering approximately a dozen areas of chemistry, was recognized by many medals and memberships in learned societies throughout the world, including the National Academy of Sciences and the Nichols Medal of the American Chemical Society. Best known to the general public is his work on synthetic rubber. During World War II, the government established a comprehensive research program at major industrial companies and several universities, including Minnesota. Kolthoff quickly assembled a large research group and made major contributions to the program. Many of Kolthoff's graduate students went on to successful careers in industry and academic life and, in turn, trained many more. In 1982, it was estimated that approximately 1,100 Ph.D. holders could trace their scientific roots to Kolthoff. When the American Chemical Society inaugurated an award for excellence in 1983, he was the first recipient.

