UNIVERSITÀ DEGLI STUDI DI TORINO

Laudatio del Prof. Claudio Minero

Prof. Fujishima is a world recognized scientist, with more than 700 published papers and patents, with an h-index 80 (more than 80 papers have been cited for more than 80 times) and more than 36000 citations since 1996. This giant bibliographic impact is due to his numerous activities as a photoelectrochemist, with early interests in the use of solar light.

His interests were many, in a variety of fields where he was a pioneer and a seed for the research of others. Starting in the late 1960s, he has been involved in an unfolding story whose main character is the fascinating material titanium dioxide (TiO2).

The scientific career of prof. Fujishima started very early when he was a student of Prof. Kenichi Honda at Tokyo University and later at Kanagawa University in Yokohama, when they published a paper on Nature (1972), with the title "Electrochemical photolysis of water at a semiconductor electrode". One of the first types of electrode materials he looked at was semiconducting TiO_2, partly because it has a sufficiently positive valence band edge to oxidize water to oxygen. The possibility of solar photoelectrolysis was demonstrated for the first time with a system in which an n-type TiO_2 semiconductor electrode was connected through an electrical load to a platinum black counter electrode under exposure to near-UV light. This paper remained out of sight for years, but later opened a vast research field on the application of semiconductors for use and catching of solar light. This paper is one of the most cited papers in the field of photocatalysis and solar energy conversion, actually with more than 5400 citations since 1996.

All of the extensive knowledge that was gained during the development of semiconductor photoelectrochemistry during the 1970 and 1980s has greatly assisted the development of photocatalysis (N. Serpone, E. Pelizzetti (Eds.), Photocatalysis: Fundamentals and Applications, Wiley, New York, 1989). In particular, it turned out that TiO_2 is excellent for photocatalytically breaking down organic compounds and for environmental applications, as evidenced by the extensive global efforts in this area since then.

Prof. Fujishima deeply contributed to the area of environmental photocatalysis with studies on the interaction and abatement of gaseous pollutants, developing for the first time efficient titania thin films, with reviews for dissemination, and with patents for its application, and then discovered new properties including self-cleaning surfaces, and most recently photoinduced hydrophilicity, which involves not only self-cleaning surfaces, but also antifogging ones. The Fujishima group discovered and first explained the superhydrophilicity, the phenomenon by which a surface increases its wetting after light exposure. The explanation is both on a photocatalytic phenomenon and on surface modifications due to bridging oxygen oxidation, which creates oxygen vacancies. Water molecules can then occupy these oxygen vacancies, producing adsorbed OH groups, which tend to make the surface hydrophilic. The longer the surface is illuminated with UV light, the smaller the contact angle for water is. This was extensively proved by several investigation techniques that assessed a light-induced lotus effect. A single surface exhibits both hydrophilic and oleophilic properties. The major applications of this effect are the self-cleaning of surfaces, the antifogging effect and biocompatibility. As on a superhydrophilic surface no water droplets are formed, the uniform film of water does not scatter light, and depending on the humidity, it can be sufficiently thin to evaporate quickly, leading also to self cooling properties of the surface.

All the above discovered properties give the materials new properties that opened new market niches.

As far back as the mid-1980s, Prof. Fujishima was interested in using the strong oxidizing power of illuminated TiO_2 to kill tumor cells, in its cytotoxicity, and antiviral and biocide activity for application on photocatalytic sterilization and selective killing of single cancerous cells.

In addition to these main research interests, Prof. Fujishima was active with success in other fields. When he was still in the Honda group (1980-1990), numerous papers witness basic contributions to photoelectrochemistry investigations, with the introduction of new instrumental approaches like photothermal spectroscopy, photoacustic, time resolved reflectometry, pulsed laser-induced photopotentials, waveguide applications, and to analytical applications of electrochemical techniques. Photochromic and electrochromic effects have been also investigated (Nature 1992). He contributed to the emerging field of photoelectrochemical information storage with studies on the use of dyes (Nature 1992) and on the induction of magnetic phase transition by optical stimulus using cobalt-iron and chromium cyanides (papers on Science 1996).

For all these reasons, the Faculty of Science of University of Torino is proud to add Professor Akira Fujishima’s name to its list of honorary doctorates and to give him Laurea Honoris Causa in

Chimica dell'Ambiente, to acknowledge his outstanding contributions to the field of photoelectrochemistry and photocatalysis, and to the research and energy/environmental applications of photofunctional properties of materials.