



Biography of Constantinos G. Vayenas

Constantinos (Costas) Vayenas was born in Athens in 1950 and studied Chemical Engineering at the National Technical University of Athens (NTU, 1968-1973). He received his PhD from the University of Rochester in NY, USA in 1976 and then taught as Assistant Professor at Yale University (1976-77) and as Assistant and Associate Professor at the Massachusetts Institute of Technology (MIT, 1977-82). Since 1982 he is Professor of Chemical Engineering at the University of Patras. He has also been Visiting Professor at Yale, EPFL (Lausanne) and the University of Lyon. His research focuses in the areas of Catalysis, Electrochemistry and mathematical modeling of physicochemical and elementary particle phenomena. He has coauthored some 270 refereed publications in International Journals, four of them in the Journals Science and Nature.

He has received several international Awards which include the Outstanding Achievement Award of the High Temperature Materials Division of the Electrochemical Society (ECS) in 1996, the Wason Medal for Materials Research of the American Concrete Institute in 1992, the Chemistry Award of the Academy of Athens in 1992, and the Outstanding Faculty Award of the Chemical Engineering Department at MIT in 1979 and 1981. Together with his coworkers at MIT and at the University of Patras he has discovered the phenomenon of the Non-Faradaic Electrochemical Modification of Catalytic Activity (NEMCA effect) which is also known in the literature as the phenomenon of the **Electrochemical Promotion of Catalysis (EPOC)**.

This phenomenon allows for the operando reversible enhancement and control of the rate and selectivity of catalytic reactions on electronically conductive catalysts supported on ionic or mixed ionic electronic conducting supports via application of small

(± 2 V) potentials between the catalyst and a counter electrode. In this way promoting or poisoning species are forced to migrate in situ from the support to the catalyst surface and alter its electronic properties, such as the work function, and thus also its catalytic properties. The observed catalytic rate enhancement can exceed the Faradaic rate of promoter supply by up to five orders of magnitude. The study of this phenomenon has shed new light on the mechanism of metal-support interactions (MSI) and has allowed for the systematic study of the role of promoters in heterogeneous catalysis, leading to simple rules for promoter selection on the basis of the unpromoted catalytic kinetics.

Costas is also credited for developing a novel recycle reactor design for the oxidative coupling of methane, for designing and modelling novel solid electrolyte fuel cells and for developing successful predictive mathematical models for the **carbonation of reinforced concrete** (for which he has received the Wason medal of the ACI) and for the properties and transport of protons in nafion membranes and other media.

In recent years he is also investigating **the thermodynamics and catalysis of hadronization** and has developed Bohr-type rotating relativistic lepton models for hadrons and bosons using special relativity and gravity as the attractive force. These models contain no adjustable parameters and are in close agreement with experiment. In 2005 he was elected Fellow of the International Society of Electrochemistry (ISE), being chronologically the 14th scientist to receive this honour.

He is Editor of the book series "Modern Aspects of Electrochemistry" and has coauthored three books published by Springer and Marcel Dekker, i.e. "Electrochemical Activation of Catalysis: Promotion, Electrochemical Promotion and Metal-Support Interactions", Kluwer/Plenum Press, 2001, "Catalysis and Electrocatalysis at Nanoparticles Surfaces", Marcel Dekker, 2003, "Gravity, special relativity and the strong force: A Bohr-Einstein-de Broglie model for the formation of hadrons", Springer 2012. He has supervised 38 PhD Theses and 18 of these PhD students have become Professors in Greek but also non-Greek (USA, China) Universities and Research Centers. In 2010 he was elected as one of the 45 full members of the Academy of Athens and in 2015 he received an Honorary PhD degree from the Aristotle University of Thessaloniki. In 2017

he was the first Greek scientist to be elected as Foreign member of the National Academy of Engineering (NAE) of the USA.