化學獎》表面化學受肯定 德**(19**年後**)**學者奪化學獎

Nobel Prize in Chemistry for 2007 ：

"for his studies of chemical processes on solid surfaces".

Gerhard Ertl, b. 1936, http://w3.rz-berlin.mpg.de/pc/PCarchive2.html
Fritz-Haber-Institut der Max-Planck-Gesellschaft,
Berlin, Germany

Modern surface chemistry – fuel cells, artificial fertilizers and clean exhaust

The Nobel Prize in Chemistry for 2007 is awarded for groundbreaking studies in surface chemistry. This science is important for the chemical industry and can help us to understand such varied processes as why iron rusts, how fuel cells function and how the catalysts in our cars work. Chemical reactions on catalytic surfaces play a vital role in many industrial operations, such as the production of artificial fertilizers. Surface chemistry can even explain the destruction of the ozone layer, as vital steps in the reaction actually take place on the surfaces of small crystals of ice in the stratosphere. The semiconductor industry is yet another area that depends on knowledge of surface chemistry.

AES Auger Electron Spectroscopy
FTIR Fourier Transform Infrared Spectroscopy
HREELS High Resolution Electron Energy Loss Spectroscopy
LEED Low Energy Electron Diffraction
PEEM PhotoEmission Electron Microscopy
SIMS Secondary Ion Mass Spectroscopy
UPS Ultraviolet Photoelectron Spectroscopy

2007年諾貝爾化學獎得主

艾爾特（Gerhard Ertl）

國籍	德國
1936年10/10	出生於德國斯圖加特
1965年	獲慕尼黑技術大學博士學位
1968至1973年	擔任漢諾威技術大學教授
1973至1986年	擔任慕尼黑大學教授 曾任美國加州理工學院、密爾瓦基威斯康辛大學、柏克萊加州大學等校訪問教授
1986至2004年	擔任柏林馬克斯普朗克學會「費里茨哈柏研究所」物理化學部主任，2004年成為名譽教授
研究領域	表面化學、固體表面的化學反應機制

自1988年來，第一個拿到諾貝爾化學獎的德國人

圖片來源／歐洲圖片新聞社　資料來源／馬克斯普朗克學會、維基百科
製　表／王先棠

德國科學家艾爾特榮獲二○○七年諾貝爾化學獎。瑞典皇家科學院十日表示，艾爾特發明新的實驗方法以研究固體表面的化學反應，他在「表面化學領域的開拓性研究」，是了解臭氧層何以日益稀薄等問題的關鍵。

瑞典皇家科學院在頌辭中強調，艾爾特的研究為現代表面化學的發展奠定基礎，他的研究成果讓人更瞭解燃料電池如何運作、觸媒轉化器如何淨化汽車廢氣、鐵為何生鏽，也讓人更瞭解大氣平流層中微小冰晶表面的化學反應如何破壞臭氧層。

艾爾特研究以鐵當催化劑從空氣中抽出氮的化學過程，此程序可以用來製造人造肥料，對經濟發展貢獻甚大。他還研究一氧化碳在白金上的氧化過程，這種化學反應可以應用在淨化車輛廢氣的觸媒轉化器。

艾爾特也是把半導體產業研發出的新技術用於物質表面反應的先驅。他利用了先進的高真空實驗器材研究金屬表面的原子、分子層的動態。

艾爾特是十九年來第一個拿到化學獎的德國人。德國人上次獲得化學獎是在一九八八年，由三位學者合得。

It was thanks to processes developed in the semiconductor industry that the modern science of surface chemistry began to emerge in the 1960s. **Gerhard Ertl** was one of the first to see the potential of these new techniques. Step by step he has created a methodology for surface chemistry by demonstrating how different experimental procedures can be used to provide a complete picture of a surface reaction. This science requires advanced high-vacuum experimental equipment as the aim is to observe how individual layers of atoms and molecules behave on the extremely pure surface of a metal, for instance. It must therefore be possible to determine exactly which element is admitted to the system. Contamination could jeopardize all the measurements. Acquiring a complete picture of the reaction requires great precision and a combination of many different experimental techniques.

It was thanks to processes developed in the semiconductor industry that the modern science of surface chemistry began to emerge in the 1960s. **Gerhard Ertl** was one of the first to see the potential of these new techniques. Step by step he has created a methodology for surface chemistry by demonstrating how different experimental procedures can be used to provide a complete picture of a surface reaction. This science requires advanced high-vacuum experimental equipment as the aim is to observe how individual layers of atoms and molecules behave on the extremely pure surface of a metal, for instance. It must therefore be possible to determine exactly which element is admitted to the system. Contamination could jeopardize all the measurements. Acquiring a complete picture of the reaction requires great precision and a combination of many different experimental techniques.

From artificial fertilizers to clean exhaust

Surface reactions are vital in many processes today
– in catalytic cleaning carbon monoxide oxidates on platinum,
– freons used in air conditioning systems, for instance, reduce the ozone layer by reacting on the surfaces of small ice crystals,
– rusting takes place when an iron surface is exposed to oxygen,
– surface reactions are used in the electronics industry to manufacture semiconductor materials for components,
– artificial fertilizers contain ammonia which is produced when nitrogen and hydrogen react on an iron surface,
– renewable fuels can be produced using catalytic surfaces.

Ertl's contributionsTo the surface chemical dynamics

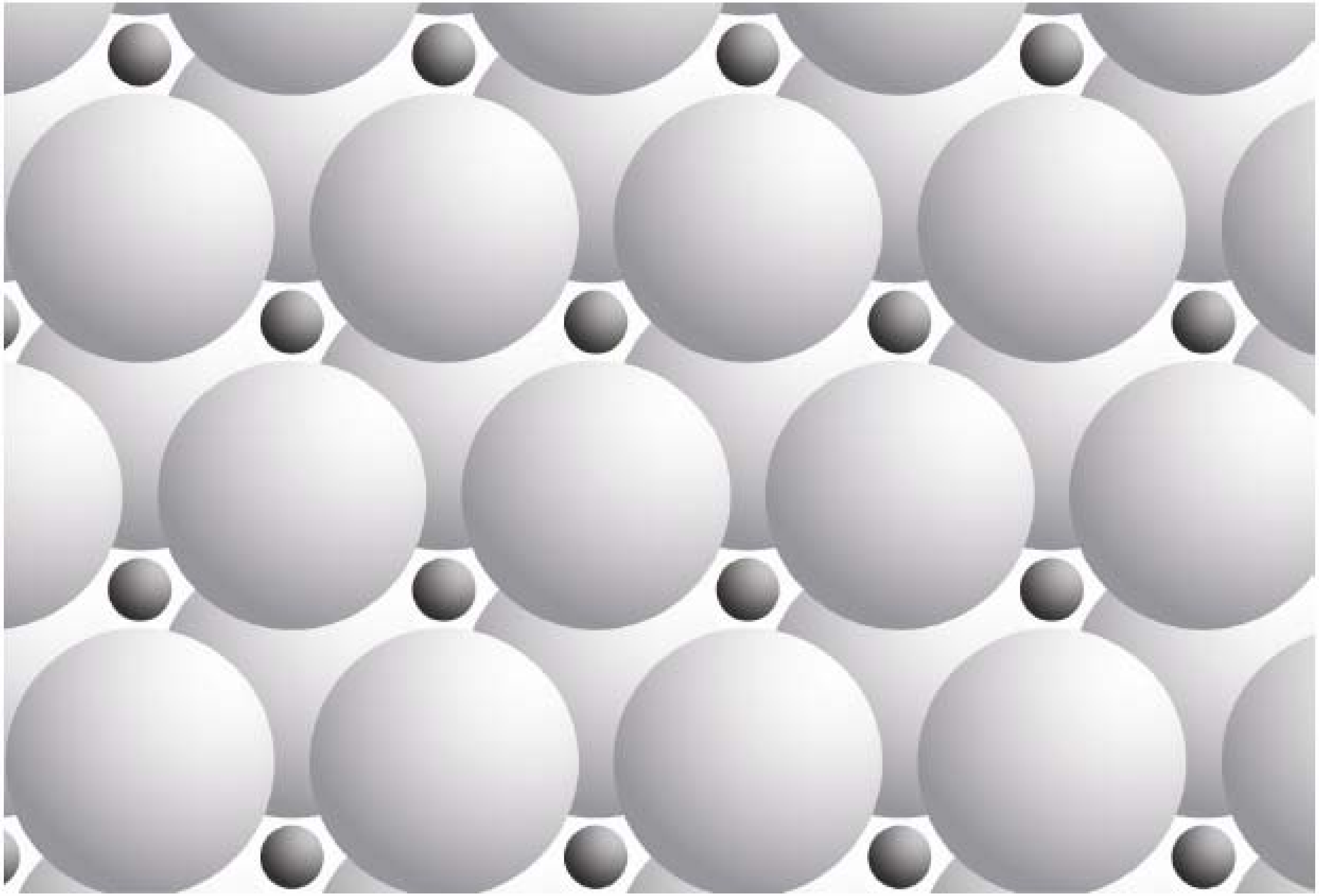
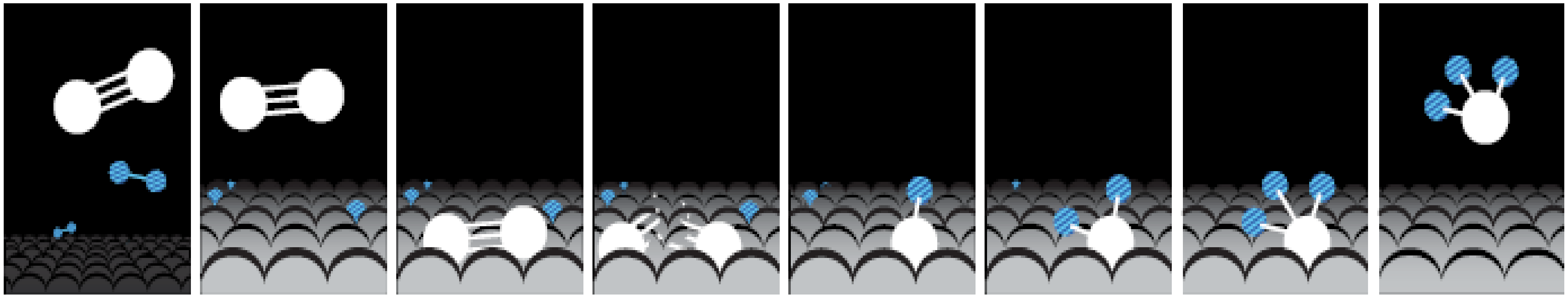


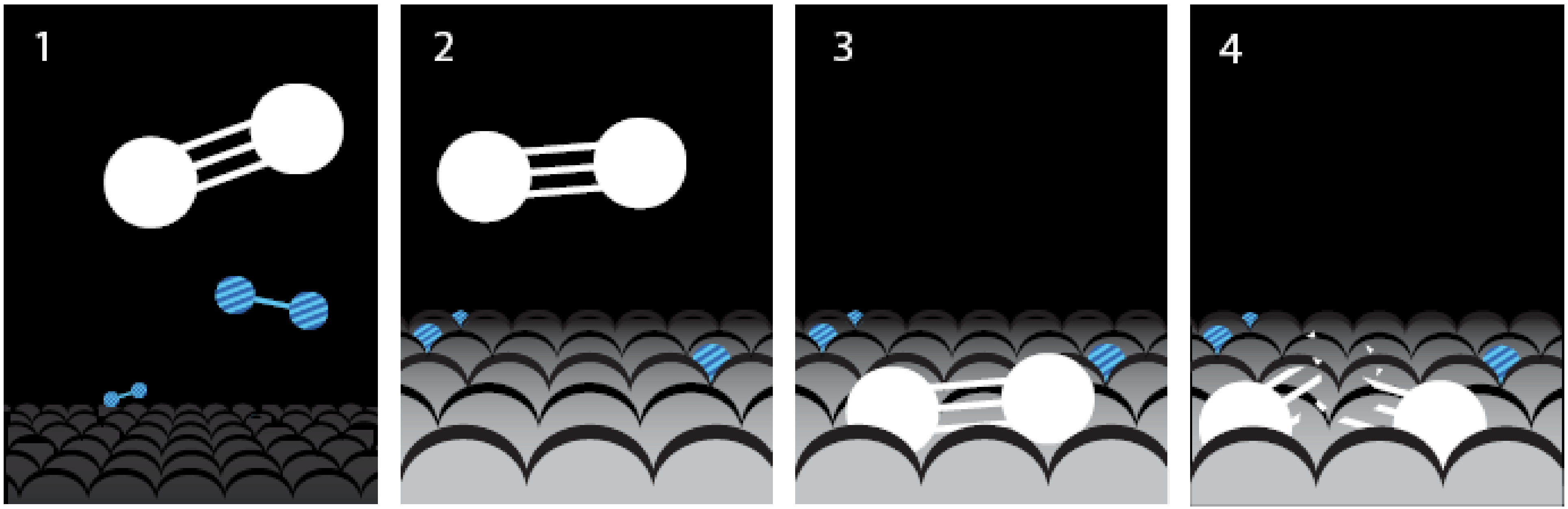
Illustration of how the hydrogen atoms, small spheres, are organized in a monolayer on a (111) platinum surface. (Adapted from Badescu et al. 2003)

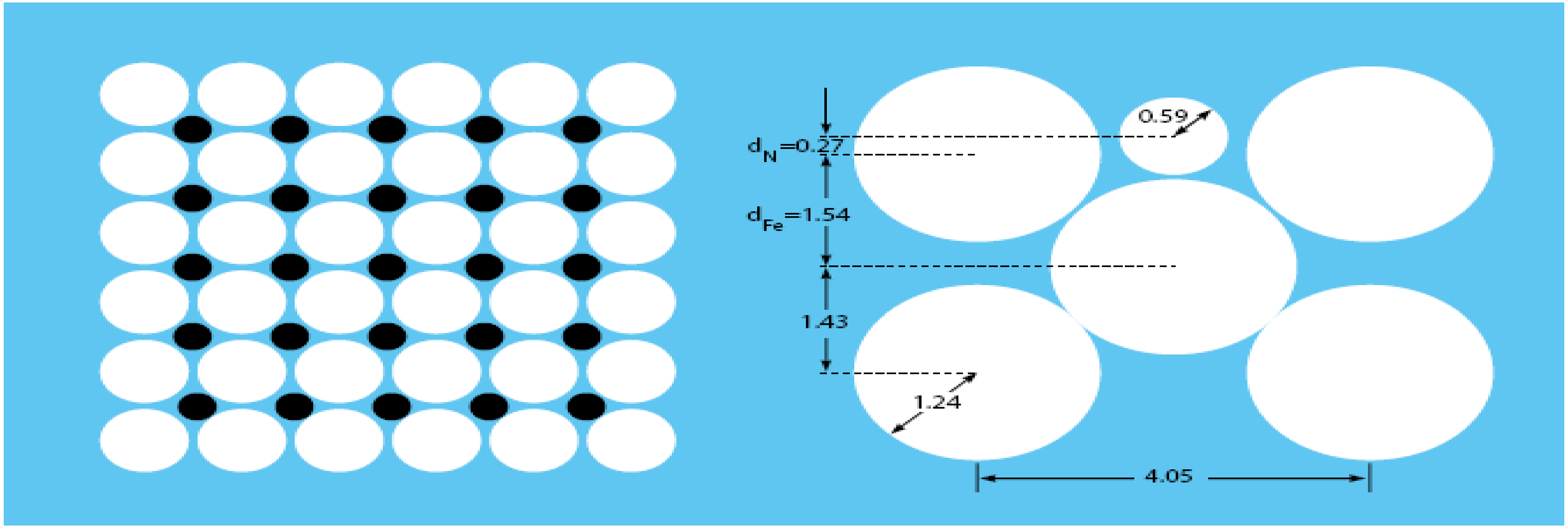
The emergence of modern surface chemistry

The Haber-Bosch process step-by-step



In the Haber-Bosch process nitrogen (white) reacts with hyrogen (striped) on an iron surface to then form molecules of ammonia which are released from the surface. This reaction, which extracts nitrogen from air, is an important step in the production of artificial fertilizer.





Structure of an overlayer of nitrogen atoms (small filled circles) on a (100) surface of iron (large open circles). Left: top view; right: side view. (Adapted from Imbihl et al. 1982)

$$NH_{3,ad} \rightleftharpoons NH_{2,ad} + H_{ad}/D_{ad}$$

$$H_2 \rightleftharpoons 2\,H_{ad}$$

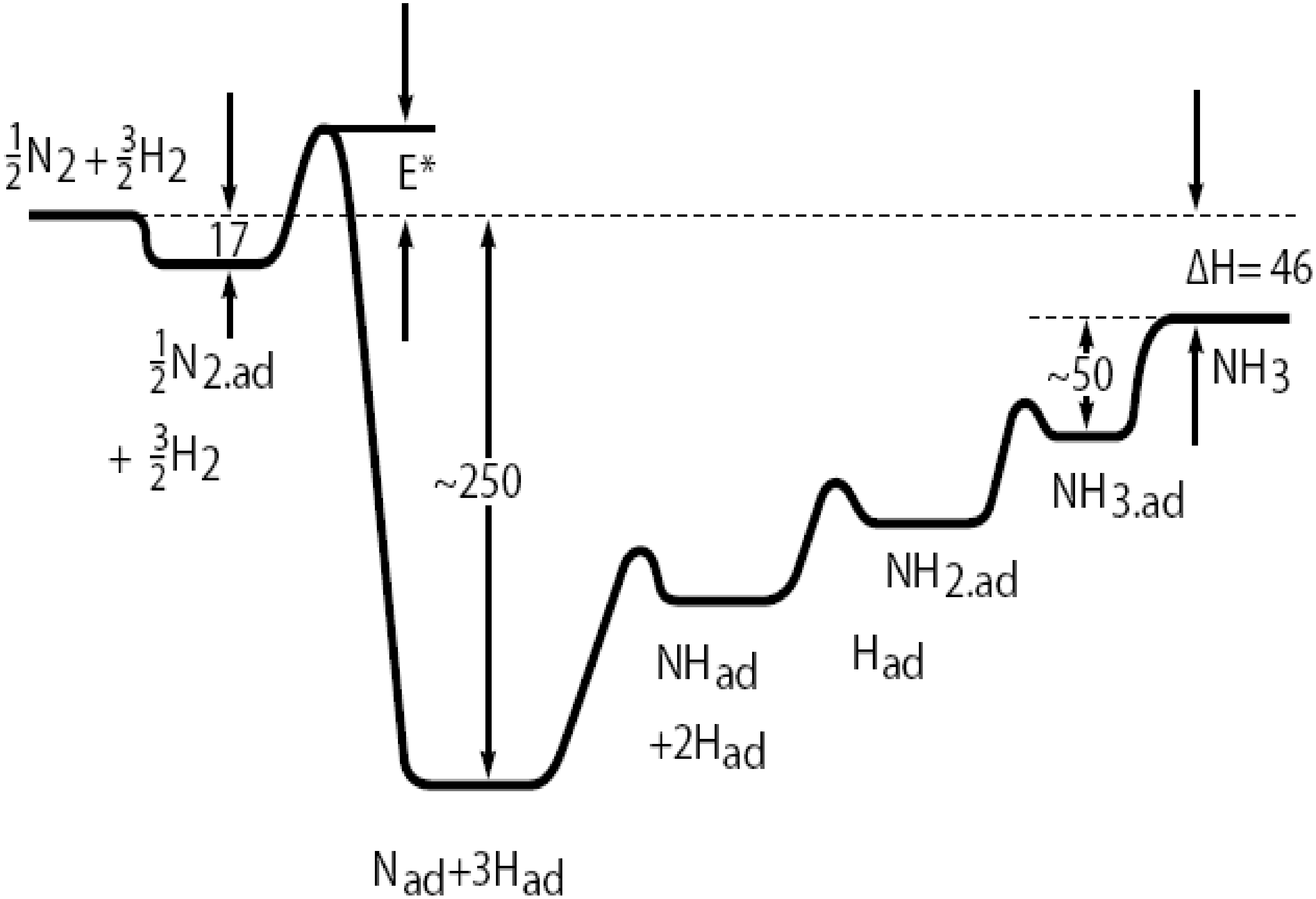
$$N_2 \rightleftharpoons N_{2,ad} \rightleftharpoons 2\,N_s$$

$$N_s + H_{ad} \rightleftharpoons NH_{ad}$$

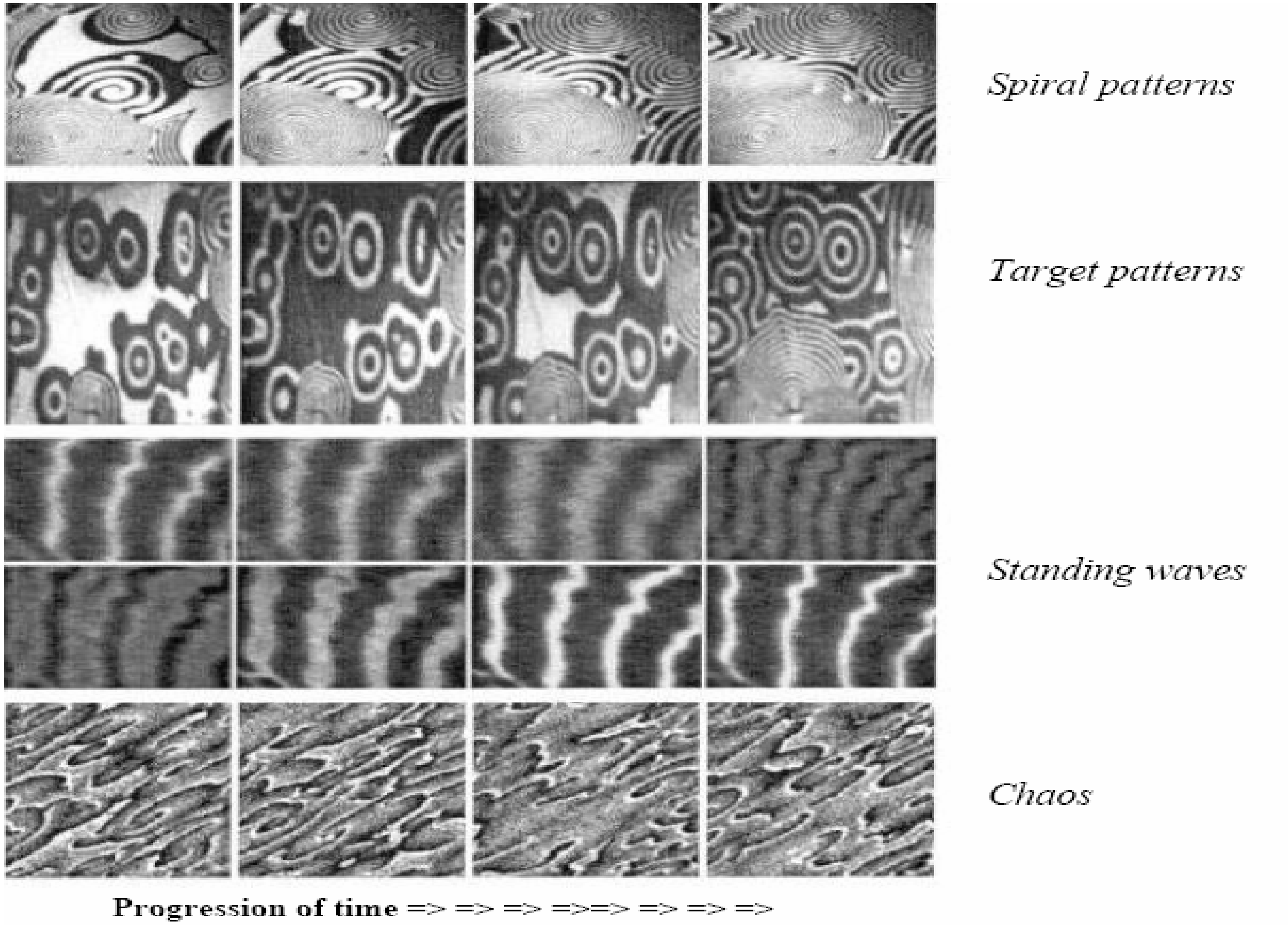
$$NH_{ad} + H_{ad} \rightleftharpoons NH_{2,ad}$$

$$NH_{2,ad} + H_{ad} \rightleftharpoons NH_{3,ad}$$

$$NH_{3,ad} \rightleftharpoons NH_3$$



An energy diagram showing the progression of the reaction from the reactants N_2 and H_2 to the product NH_3. Energies are given in units of kJ/mol. (Adapted from Ertl 1983)



Platinum surface imaged by photoemission electron microscopy. Dark areas are rich in CO while light areas are O2 rich. Note the oscillatory behavior of the domain extensions. Time scale ~10s, length scale ~0.1mm (The Surface Imaging Group, Dept. of Physical Chemistry, Fritz-Haber-Institute of the Max-Planck-Society, www.fhi-berlin.mpg.de/surfimag)

Background

Due to its major importance in chemistry the study of chemical processes at surfaces and interfaces has a long history. In 1912 P. Sabatier was awarded one half of the Nobel Prize for “his method of hydrogenating organic compounds in the presence of finely disintegrated metals whereby the progress of organic chemistry has been greatly advanced in recent years”. It was later realized that the crucial molecular event in this method is the adsorption of hydrogen molecules on the metal surface, where it is dissociated into the constituent hydrogen atoms. The method, properly refined, still remains today a standard procedure for hydrogenation of organic molecules. Heterogeneous catalysis was also the central process behind the award of the Nobel Prize to F. Haber “for the synthesis of ammonia from its elements”. Even though technical improvements have been made, the same basic concept is used in the modern version of the process. In 1932 the chemistry prize was awarded to I. Langmuir “for his discoveries and investigations in surface chemistry”. Langmuir made a range of seminal contributions relevant to both heterogeneous catalysis and to processes at the air-water interface. His name is associated in the literature with the “Langmuir adsorption isotherm”, “the Langmuir through” and the “Langmuir-Hinshelwood scheme” for heterogeneous catalytic reactions. Since 1932 there has been no Nobel Prize in chemistry that specifically addresses the field of chemical processes on surfaces. In 1956, however, it was awarded to C.N. Hinshelwood and N.N. Semenov “for their research into the mechanisms of chemical reactions” and in 1986 the prize was given to D.R. Herschbach, Y.T. Lee and J.C.Polanyi “for their contributions concerning the dynamics of chemical elementary processes”. These latter prizes concern fundamental aspects of chemical reactions primarily occurring in the gas phase.

中國時報 2007.10.10 **教宗任命李遠哲爲教廷宗座科學院院士**中央社

教宗本篤十六世今天任命臺灣中央研究院前院長李遠哲，以及德國斯圖加市麥克斯普蘭喀固態研究所物理教授馮克里辛爲宗座科學院院士。

李遠哲爲第四位獲任命爲宗座科學院院士的華人科學家。前三人分別是一九五七年諾貝爾物理獎得主楊振寧與李政道，以及稻米專家張德慈。他們三人也都是台灣中央研究院院士。

李遠哲以研究離子和分子交叉群的光譜聞名於世。他於一九三六年十一月二十九日生於臺灣新竹，一九五九年畢業於臺灣大學化學系，一九六一年獲臺灣清華大學理學碩士學位，一九六二年赴美國深造，一九六五年獲得加州大學柏克萊分校化學博士學位。

他於一九七四年受聘爲柏克萊大學專任教授，一九八六年獲得諾貝爾化學獎，一九九四年返回臺灣，擔任中央研究院院長，並從事教育工作。二零零六年成爲中央研究院榮休院長和研究院傑出院士。

與李遠哲同日獲教宗任命爲宗座科學院院士的馮克里辛現年六十四歲，以研究電子半導體出名。他的研究成果幫助其他有關科學家進一步精確研究電子組成體的導體功能，也有助於確立測量電阻最方便的基準。他於一九八五年獲得諾貝爾物理獎。

教廷宗座科學院一六〇三年於羅馬成立，原名「林琴科學院（Linceorum Academia）」，是歐洲歷史最悠久的科學院。教宗比約十一世於一九三六年重組科學院，並更名爲宗座科學院，院址設在梵蒂岡花園的「教宗比約四世卡西納宮」。

宗座科學院是天主教普世教會最高的學術權威機構，目前有院士八十位，都是享譽世界的各門科學專家，其中有二十多位是諾貝爾獎的得主。

科學院的主要工作目標是推展數學、物理與自然科學、以及與傳染病有關的問題之研究，設九個主要學門，分別爲物理、天文、化學、地球與環境科學、生命科學、數學、應用科學、哲學與科學史。

科學院新院士的任命不分國籍、政治立場與宗教信仰，通常經院士推薦及全體院士同意後送請教宗任命。院士被教廷認爲是最有價值的科學資訊來源。