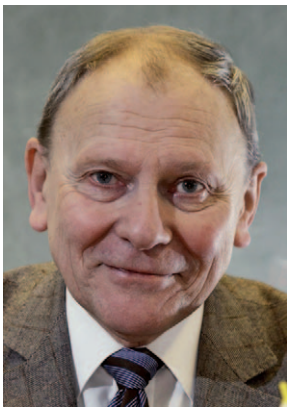


G. Férey

*The author presented on this page has recently published his **25th article** since 2000 in Angewandte Chemie*: "$[Al_4(OH)_2(OCH_3)_4(H_2N\text{-}bdc)_3]\cdot xH_2O$: A 12-Connected Porous Metal-Organic Framework with an Unprecedented Aluminum-Containing Brick": T. Ahnfeldt, N. Guillou, D. Gunzelmann, I. Margiolaki, T. Loiseau, G. Férey, J. Senker, N. Stock, *Angew. Chem.* **2009**, *121*, 5265–5268; *Angew. Chem. Int. Ed.* **2009**, *48*, 5163–5166.

Gérard Férey

Date of birth:	July 14th, 1941
Position:	Professor at Institut Lavoisier (University of Versailles) and Institut Universitaire de France
Education:	1959 Baccalauréat, Saint-Lô (France) 1962–1965 MS degree, University of Caen (France) 1965–1968: PhD with L. Walter-Lévy, "Contribution to the Study of Basic Halides of Titanium(IV)", Universtiy of Caen 1968–1977 Doctorat d'Etat with R. de Pape, "Structural and Magnetic Study of 3d Transition-Metal Fluorides", Le Mans, Paris
Recent awards:	**2009** Eni Award for Protection of Environment (Italy); **2009** Foreign Member of the Royal Academy of Sciences of Spain; **2008** Catalan–Sabatier Prize (Spain); **2009** Muetterties Award (USA); **2008** Award Lecture of the Chemical Society of Japan; **2007** Clearfield Award Lecture (USA); **2008** L. Eyring Award Lecture (USA); **2005** C. N. R. Rao Award (India); **2004** Gay–Lussac–Humboldt Award of the Alexander von Humboldt Foundation (Germany); **2003** Member of the French Academy of Sciences; **2000** Grand Prix IFP of the French Academy of Sciences; **2000** Foreign Member of the National Academy of Sciences of India
Current research interests:	After a long period devoted to structural and magnetic studies on crystallized and amorphous transition-metal fluorides, I have dedicated my research to the knowledge and applications of multifunctional porous solids with either purely inorganic or hybrid frameworks, which can be rigid or flexible. I developed a global approach to this problem including structural chemistry, determination of the mechanisms of hydrothermal formation by using in situ techniques for creating tailor-made solids, computer simulations for predicting both their structures and their dynamic behavior under stimuli, and of course, properties and applications in different domains (energy, gas separation and storage, sustainable development, and health). This method is applied to many metallic elements that have various oxidation states from mono- to tetravalent
Hobbies:	Traveling, drawing, classical music

If I could be anyone for a day, I would be … the conductor of a symphonic orchestra.

When I was eighteen I wanted to be … a teacher.

The most significant scientific advance of the last 100 years has been … there are so many! Perhaps the knowledge of DNA.

The biggest problem that scientists face is … to convince the public that science is impossible to circumvent for the future of the planet.

If I could have dinner with three famous scientists from history, they would be … Marie Curie, Pierre-Gilles de Gennes, and Linus Pauling.

I chose chemistry as a career because … it is the only discipline in which we can act as architects of matter.

The most important future applications of my research are … energy, protection of the environment, and health.

My biggest inspiration is … nature.

My biggest motivation is … to understand and explain the chemistry and physics of my domain.

The worst advice I have ever been given was … to follow fashions!

My ultimate goal is to … see my best materials produced at the industrial scale for human use.

The part of my job which I enjoy the most is … waiting for the experimental verification of what I expected.

A good work day begins with … coffee!

My favorite composers are … Bach, Beethoven, and Mozart.

My favorite piece of music is … Piano Concerto No. 23 in A (Mozart).

How is chemistry research different now than it was at the beginning of your career?

When I began research as a solid-state chemist, our main goal was to *create* new solids. We were mainly devoted to the synthesis and exploration of chemical systems. At the beginning of the 1970s, increased contact and discussions with physicists led us to add physical characterizations (e.g., conductivity, magnetism) to the syntheses in our papers. Our domain became multidisciplinary and in turn developed into materials science. It called for chemists to develop another culture while keeping their initial creative one, and favored the emergence of new *chemical* ideas concerning the properties of solids. Moreover, the development of physical characterization techniques since the mid 1980s in diffraction and spectroscopy, coupled with the appearance of large instrument facilities and time-resolved techniques, now allow chemists to have fantastic tools to gain knowledge of their products, and therefore, better access to their possible modifications and improvements. Finally, the development of chemical computer science has given a new dimension to chemistry, which will be of paramount importance in the future: the possibility of prediction.

Has your approach to chemistry research changed since the start of your career?

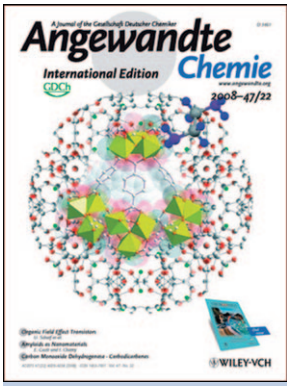
Yes. At the beginning of my career, we were the *discoverers* of new phases that we identified by chemical analysis and X-ray powder diffraction. The assimilation of crystallographic knowledge then transformed our discipline into structural chemistry. Furthermore, the introduction of new synthetic techniques at low temperatures (solvothermal synthesis) provided new avenues for the discovery of new solids, and illustrated the importance of the nature of precursors on that of the final solid. Coupled with the introduction of physics in our discipline, this lead us to move from solid-state chemistry to materials science, based on the magic triangle (synthesis, structure, and properties), which gave us the opportunity to discover many famous families of solids such as superconductors and strong magnets. But in my opinion, despite these spectacular results and the huge number of phases that contributed to the databases, we were always *submitted* to the results of synthesis without the possibility to imagine and/or master them. For certain classes of solids (e.g., 3D porous solids, hydrothermally synthesized at low temperature), this could only be done by taking time to study the mechanisms of reaction, identify the reactive species, and correlate them with the structure of the final solids. This drastically changed my approach to chemistry—from deductive, it became inductive. It was particularly true for hybrid porous solids. The development of in situ methods in real time proved that the inorganic species that existed in the final solids already existed as reactive species during the solvothermal synthesis, with the real-time methods allowing us to reach the kinetics of the reaction. The knowledge of the inorganic building blocks beside the organic ligands *during* the reaction allows us to begin the rational construction of the crystallized porous solid from its initial constituents when looking at the different possibilities of structural connections between them with the help of computer science.

Has your approach to publishing your results changed since the start of your career?

Yes, while always maintaining the same exigence of quality. The evolution of my topics of interest caused a change in the journals in which I published. Initially, they corresponded to renowned specialized journals of chemistry and physics of the solid state. My orientation towards porous solids modified my choice journal, and concerned those of zeolites, coordination chemistry, and supramolecular chemistry. Later, some results that I considered as important incited me to submit papers in generalist top journals like *Angewandte Chemie* and *Science*.

What do you think the future holds for your field of research?

In the domain of porous solids, the only limit is our imagination. I believe that it is a new domain in chemistry and its possibilities are endless, from both the synthetic and properties and applications point of view for several reasons: 1) The existence and additive properties of both inorganic and organic moieties in the skeleton. 2) The inorganic component, which can contain almost all of the types of cations and their substitutions, reinforces the mechanic and thermal properties of the material, and rationally contributes to the physical and chemical properties of the solid. 3) The presence of so many organic linkers with their tunability in nature, length, and functionalizations considerably enriches the number of possible and modified solids with biochemical applications. 4) The additivity of the properties of both parts make these solids interesting multimaterials in several fields. 5) The unique structural character they have implies that properties can be separately addressed on each part (physical properties in the skeleton, catalysis, adsorption and separation on the internal surface, and storage and delivery of several organic, inorganic, and metallic species from the pores), and find applications in current problems facing society relating to energy, sustainable development, and health. 6) Their easy large-scale synthesis at low temperature and shaping (films, monoliths) make them interesting materials for the above industrial applications.



G. Ferey has been featured on the cover of Angewandte Chemie:
"Amine Grafting on Coordinatively Unsaturated Metal Centers of MOFs: Consequences for Catalysis and Metal Encapsulation": Y. K. Hwang, D.-Y. Hong, J.-S. Chang, S. H. Jhung, Y.-K. Seo, J. Kim, A. Vimont, M. Daturi, C. Serre, G. Férey, *Angew. Chem.* **2008**, *120*, 4212–4216; *Angew Chem. Int. Ed.* **2008**, *47*, 4144–4148.

Have you changed the main focus of your research throughout your career and if so why?

Yes, four times, from the chemistry of solutions to the chemistry and physics of transition-metal fluorides, the synthetic homologues of oxide minerals, and since 1992, inorganic and hybrid porous solids. The reasons? The increase of my scientific knowledge over the years, which could be applied to fields other than my original ones, increased my curiosity, my imagination, and my fields of interest. Also, even if I respect those who work all of their life on the same topic, I hate routine and intellectually I need change once I think that I have understood.

What has been your biggest influence/motivation?

Erwin Bertaut (Grenoble), originally a solicitor, who by passion of science and dramatic events in his life became a pioneer in solid-state chemistry, crystallography, and solid-state physics. He introduced me to magnetism during several stays in his group. The fundamental question he asked me when I showed him my results was always "Yes, but why?". This definitively influenced the rest of my scientific life and provides, whatever the topic, my motivation for understanding and explaining the chemistry leading to the products I isolate. In this way, we can progress.

What advice would you give to up-and-coming scientists?

A sentence from Mark Twain: "Twenty years from now, you will be more disappointed by the things you didn't do than by the ones you did do. So, throw off the bowlines. Sail away from the safe harbor. Catch the trade winds in your sails. Explore, Dream, Discover."

What is the secret to publishing so many high-quality papers?

No secret! Just shared passion, curiosity, creativity, and intellectual exigency. The rest corresponds to continuous hard work and the communication of passion to the young generations (students, PhDs, and postdocs). We are just intermediary species…

My 5 top papers:

1. "Ordered Magnetic Frustration: VIII. Crystal and Magnetic Structures of the Pyrochlore Form of FeF_3 between 2.5 and 25 K from Powder Neutron Diffraction. Comparison With the Other Forms of FeF_3": G. Férey, R. de Pape, M. Leblanc, J. Pannetier, *Rev. Chim. Miner.* **1986**, *23*, 474–484.
   This solid-state chemistry contribution illustrated the importance of the nature of precursors on the final topology of the different polytypes of a solid. In the different forms of FeF_3 that we isolated, the Néel temperature varied by more than two orders of magnitude by just changing the topology.
2. "A Breathing Hybrid Organic-Inorganic Solid with Very Large Pores and High Magnetic Characteristics": K. Barthelet, J. Marrot, D. Riou, G. Férey, *Angew. Chem.* **2002**, *114*, 291–294; *Angew. Chem. Int. Ed.* **2002**, *41*, 281–284.
   This was our first paper on highly flexible hybrid porous solids with a large magnitude of swelling, which can now reach more than 300% of the cell volume expansion, and is coupled with hysteresis phenomena during desorption. This feature allows much greater amounts of guests (mainly poisonous gases) to be stored and released, and finds applications in gas storage.
3. "A Chromium Terephthalate-Based Solid with Unusually Large Pore Volumes and Surface Area": G. Férey, C. Mellot-Draznieks, C. Serre, F. Millange, J. Dutour, S. Surblé, I. Margiolaki, *Science* **2005**, *309*, 2040–2044.
   This solid (MIL-101) was obtained and characterized by using the global approach described above by combining mastered chemistry and simulation. It is the largest crystallized mesoporous solid (cell volume > 700000 $Å^3$) with unprecedented surface area (ca. 6000 $m^2 g^{-1}$), and able to host large amounts of gases (including hydrogen and greenhouse gases), inorganic, organic, and metallic species. It currently represents most of the possibilities of hybrid porous solids to act as efficient multimaterials.
4. "Metal-Organic Frameworks as Efficient Materials for Drug Delivery": P. Horcajada, C. Serre, M. Vallet-Regi, M. Seban, F. Taulelle, G. Férey, *Angew. Chem.* **2006**, *118*, 6120–6124; *Angew. Chem. Int. Ed.* **2006**, *45*, 5974–5978.
   Not only is MIL-101 able to store and deliver very large amounts of drugs, but it shows that the use of hybrids represents a new route for this purpose, combining the advantages of the previous methods without introducing their weaknesses. Moreover, the time for linear delivery can reach three weeks. Validated with ibuprofen, our method is now applied to the in vivo tests of storage and delivery of antiviral and antitumoral drugs. When iron-based solids are used, their nontoxicity has been proven and, in addition, their activity in imaging allows us to follow the path taken by the drug in the body. This behaviour will probably represent one the most important applications of porous hybrid solids in the future.
5. "Experimental Evidence Supported by Simulations of a Very High H_2 Diffusion in Metal Organic Framework Materials": F. Salles, H. Jobic, G. Maurin, M. M. Koza, T. Devic, C. Serre, G. Férey, *Phys. Rev. Lett.* **2008**, *100*, 245901–245906.
   This paper focuses on the rarely studied dynamic aspects of the adsorption of gases in hybrid porous solids with the combination of experiment (by quasielastic neutron scattering) and simulation to explaining the mobility of the guests, their dependence on structural characteristics, and their time of residence on the adsorption sites. This knowledge will be important for the problems related to hydrogen storage and the applications it implies.

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