M. Haruta

The author presented on this page has recently published his ***10th article*** *in Angewandte Chemie in the last 10 years:*
"Chance and Necessity: My Encounter with Gold Catalysts": M. Haruta, *Angew. Chem.* **2014**, *126*, 54–58; *Angew. Chem. Int. Ed.* **2014**, *53*, 52–56.

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Education:	1970 BS, Nagoya Institute of Technology 1976 PhD with Professor Nobuatsu Watanabe, Kyoto University 1981–1982 Visiting researcher with Professor Bernard Delmon, Université Catholique de Louvain
Awards:	**1997** 15th Osaka Science Prize; **2002** Catalysis Society of Japan Award; Henry J. Albert Award, International Precious Metals Institute; **2009** Foreign Member, Academia Europaea; **2010** Chemical Society of Japan Award; **2011** Spiers Memorial Award, Royal Society of Chemistry; **2012** Thompson Reuters Citation Laureate
Current research interests:	Preparation of gold nanoparticles and clusters supported on a variety of base-metal oxides, carbon materials, and polymers, and their applications to novel catalysis for green sustainable chemistry, in particular, room-temperature oxidation of hazardous gases such as CO and HCHO, and gas-phase selective oxidation of ethanol with molecular oxygen to acetaldehyde and acetic acid, and of propylene to propylene epoxide; applications have also been extended to liquid-phase reactions, such as one-pot syntheses of secondary amines from benzyl alcohol and aniline derivatives in a nitrogen atmosphere
Hobbies:	Pottery

My favorite painter is … Johannes Vermeer, who drew the *Art of Painting*.

If I had one year of paid leave I would … go to France and visit many small and beautiful villages.

My favorite word is … "Self prophecy": to predict what I want to be and make efforts to realize it. I learnt this word from Professor Amemiya, who taught me English at Nagoya Junior High School and whom I deeply respected.

I admire … Sumio Iijima, who is famous for the discovery of carbon nanotubes, because he has continued to be an active player in the area of material sciences, even at the age of 75 years.

I get advice from … Kenji Tamaru (University of Tokyo) about gold nanomedicine and Bernard Delmon (Université Catholique de Louvain) about the design of artificial gold catalysts based on enzyme structures.

I advise my students to … do more and more experiments and interpret the results logically by reading related papers and books.

My favorite way to spend a holiday is … to watch Mount Fuji and enjoy lunch with my wife in our apartment, or to visit our daughter and son to play with our five grandchildren.

In the future I see myself … in my hometown, Tajimi city near Nagoya, making pottery.

The principal aspect of my personality is … I am "sympathetic". This was often said when I stayed in Belgium as a visiting researcher.

My favorite author (science) is … Enrique Iglesia (University of California, Berkeley) because his papers are perfectly consistent and the experiments are carefully carried out.

The greatest scientific advance of the last decade was … nanoscience and nanotechnology, which have changed physical, chemical, and biological properties of materials, devices, and medicines.

When I was eighteen I wanted to … be the successor of my father's business and own a factory producing ultramarine blue pigment.

I am waiting for the day when someone will discover … a nanomedicine composed of gold clusters that selectively kills cancer cells without any side effects.

Looking back over my career, I … am very lucky to have chosen unique subjects of research, electrochemistry in hydrogen fluoride and gold catalysis. What I chose were two extremes—highly reactive fluorine and chemically inert gold.

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

Creative and exploratory research in universities and public research institutes has become less appreciated; there was a shift to practical research with little conceptual impact. There seem to be several reasons for this. Firstly, analytical tools have become highly advanced. Because of this, the fraction of tools that are only used as "black boxes" has remarkably increased in experiments. Secondly, the pressure to publish papers in prestigious journals is becoming stronger and stronger. Thirdly, obtaining grants is becoming more important for promotion, which may discourage young scientists to tackle new areas of research and to open the frontiers of science. Fourthly, I have an impression that young scientists and students now spend more time doing desk work. I believe that experiments are good teachers, and give us a chance to think for ourselves.

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

There is no secret at all. Just explore thoroughly what is interesting and what has not been studied yet. In principle, we submit our papers to journals with the scope that most fits the contents of our papers. This is simply because we wish that more people will read our papers. We are not conscious about impact factors of journals.

My 5 top papers:

1. "Novel Gold Catalysts for the Oxidation of Carbon Monoxide at a Temperature far Below 0°C": M. Haruta, T. Kobayashi, H. Sano, N. Yamada, *Chem. Lett.* **1987**, 75–87.
   Gold-containing metal oxides (Fe_2O_3, Co_3O_4, and NiO) prepared by coprecipitation are catalytically much more active than supported Pd and Pt catalysts and can convert CO into CO_2 even at a temperature as low as −70°C.
2. "Gold catalysts prepared by coprecipitation for low-temperature oxidation of hydrogen and of carbon monoxide": M. Haruta, N. Yamada, T. Kobayashi, S. Iijima, *J. Catal.* **1989**, *115*, 301–309.
   Gold nanoparticles deposited on base-metal oxides exhibit higher catalytic activity for CO oxidation than hydrogen oxidation. In order to exhibit catalytic activity for CO oxidation at −77°C, the gold nanoparticles should be smaller than 10 nm in diameter and the support metal oxides should be carefully chosen.
3. "Vital Role of Moisture in the Catalysis of Supported Gold Nanoparticles": M. Daté, M. Okumura, S. Tsubota, M. Haruta, *Angew. Chem.* **2004**, *116*, 2181–2184; *Angew. Chem. Int. Ed.* **2004**, *43*, 2129–2132.
   The enhancing effect of moisture in a wide concentration range from 0.1 to 6000 ppm in CO oxidation by using an ultraclean flow-type reactor is described. Gold nanoparticles supported on semiconductive metal oxides are active without moisture, however, gold supported on insulating metal oxides such as Al_2O_3 and SiO_2 need moisture above 100 ppm.
4. "Low-temperature oxidation of CO catalyzed by Co_3O_4 nanorods": X. Xie, Y. Li, Z.-Q. Liu, M. Haruta, W. Shen, *Nature* **2009**, *458*, 746–749.
   The morphology of base-metal oxides is crucial in determining their catalytic activity for CO oxidation. Nanorods of Co_3O_4 expose their {110} planes with a surface fraction of 41%. This surface richness results in catalytic activity of the nanorods even at −77°C in the presence of up to 10 ppm moisture.
5. "Propene Epoxidation with Dioxygen Catalyzed by Gold Clusters": J. Huang, T. Akita, J. Faye, T. Fujitani, T. Takei, M. Haruta, *Angew. Chem.* **2009**, *121*, 8002–8006; *Angew. Chem. Int. Ed.* **2009**, *48*, 7862–7866.
   Propene epoxidation takes place with molecular oxygen alone in the presence of gold catalysts in the gas phase. By using gold clusters deposited on alkali-treated TS-1 and in the presence of water vapor, propene epoxide can be produced with a conversion of 1% and a selectivity around 50%.

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