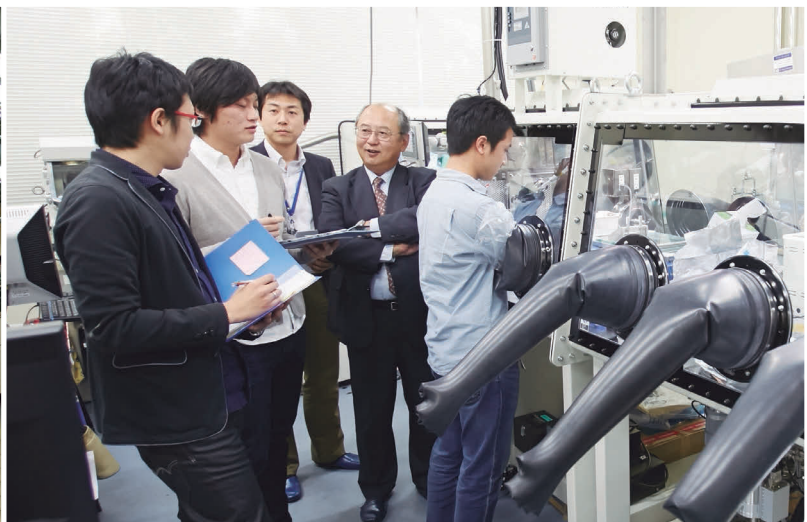




TOKYO METROPOLITAN UNIVERSITY

Tokyo's strategic partner

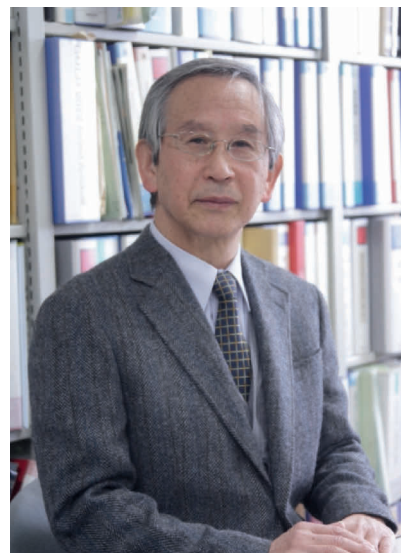
Established in 2005 but with roots dating back more than 80 years, Tokyo Metropolitan University (TMU) serves not just its students but also the metropolis of Tokyo. With the establishment of eight new world-class research centres, TMU is set to help shape the future of Tokyo and also of the world beyond.

Ranked among Japan's top universities, Tokyo Metropolitan University is highly regarded for the quality and relevance of its research. Owned by the Tokyo Metropolitan Government, TMU effectively serves as the government's think tank for solving some of the many challenges faced by the megacity of Tokyo. This unique relationship allows TMU and its researchers to contribute directly to the future of the metropolis in very tangible ways.

Pursuing 'the ideals of metropolitan society', TMU through its 28 academic departments focuses on the issues and disciplines relevant to megacities in general — such as urban infrastructure, energy and environment, health and welfare, and population ageing — as well as topics more specific to Tokyo, such as advanced disaster prevention and management.

The hosting of the 2020 Olympic and Paralympic Games by Tokyo has brought the important relationship between TMU and the Tokyo Metropolitan Government to the fore. TMU has been charged with developing some of the key technologies that promise to make the 2020 Games truly unique, engaging in research projects in areas including smart communications, advanced disaster prevention and welfare, urban environment, volunteering, regional ties and sports. The projects emphasize the practical application of research in connection with the city, governmental and municipal organizations, foreign and domestic research institutions, and business.

To stimulate and accelerate specific areas of world-class research, TMU began establishing dedicated research centres in 2014 with generous funding from the metropolitan government. The university now has 12 research centres specializing in space science; genomics and bioinformatics; artificial photosynthesis; gold chemistry; language, brain and genetics; water system engineering; community-centric systems; climatology; big social data; child and adolescent poverty; quantitative finance; and building a hydrogen energy society.



Masatake Haruta, director of the Research Center for Gold Chemistry.

Going for gold

The first of the new research centres to be established was the Research Center for Gold Chemistry. It is housed in its own new building and is under the guidance of one of TMU's most respected professors, Masatake Haruta. "In 2012, TMU hosted the Sixth International Conference on Gold Science, Technology and its Applications, and this was in many ways the catalyst for our new research centre,"

he explains, “but the history of our gold research goes back to 1982, when I first reported that gold nanoparticles can be chemically reactive.”

Gold is an extremely stable metal — in its familiar form it does not oxidize or react with other chemicals, a property that underpins its value as a precious metal. Yet thanks to research pioneered by Haruta, it is now known that as nanoparticles of 2–5 nanometres in size, gold can react usefully with certain chemicals. For example, when fixed to a base metal oxide, gold nanoparticles can oxidize carbon monoxide at temperatures as low as –70 degrees Celsius. “Not only does gold display catalytic activity, it does so at lower temperatures than conventional catalytic metals such as platinum,” says Haruta. “The discovery revealed a rich and unexplored chemistry within gold.”

Haruta found that the electronic properties of gold vary as particles get smaller. This means that gold nanoparticles of different sizes react differently, opening the way to design reaction-specific gold catalysts. “We are now looking at clusters of fewer than 200 atoms, where we can expect new catalytic properties,” he says. “We have also found structural specificity. This is the focus of our research at the Research Center for Gold Chemistry, and our point of difference with other research groups around the world.”

Already the discovery of gold nanoparticle catalysis has changed several industries. Gold is now used for vinyl chloride production and for the catalysis of methyl methacrylate — the precursor of

acrylic resin. Haruta sees the most promising applications in the production of chemicals. “Gold has the potential to dramatically change organic synthesis, replacing complex and energy-intensive synthetic routes with simpler, more efficient chemistry. It also has great promise for environmental applications, like air and water purification. We are now working on improving the catalytic life of gold nanoparticles, as well as recycling and improving stability. I think gold has a very bright future in chemistry.”

A hydrogen-fueled future

With the Tokyo Olympics just four years away, one of the great challenges put to the TMU by the Tokyo Metropolitan Government is to realize the government's goal of making the Tokyo Olympic Games a demonstration of a ‘green energy city’ based on hydrogen energy.

“Tokyo is one of the biggest cities in the world,” says Kiyoshi Kanamura, director of TMU's new Research Center for Building Hydrogen Energy Society. “To realize a green energy system using hydrogen fuel in Tokyo, we need to research and develop not only hydrogen fuel cells, but also the necessary infrastructure, such as a network of hydrogen refueling stations, and hydrogen production and carrier systems. Our new research centre will provide comprehensive and cross-cutting research for the realization of a hydrogen energy society across a wide range of disciplines.”

The work of the hydrogen research centre, the 12th to be established under

Research Centres for:

- Space Science
- Genomics and Bioinformatics
- Artificial Photosynthesis
- Gold Chemistry
- Language, Brain and Genetics
- Water System Engineering
- Community-Centric Systems
- Climatology
- Social Big Data
- Child and Adolescent Poverty
- Quantitative Finance
- Building Hydrogen Energy Society

TMU's new research centre directive, coordinates closely with that of the research centres for artificial photosynthesis and gold chemistry. “We want to use natural energy to produce hydrogen, such as biomass and solar energy, in order to realize a CO₂-free hydrogen production system,” says Kanamura. “The Tokyo Metropolitan Government has committed to exhibiting Japan's hydrogen energy society to the world at the 2020 Olympics, and the TMU through this research centre will strive to make that a reality. The outcomes from the centre, the fundamental results and know-how, will then be transferred to other megacities around the world.”



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