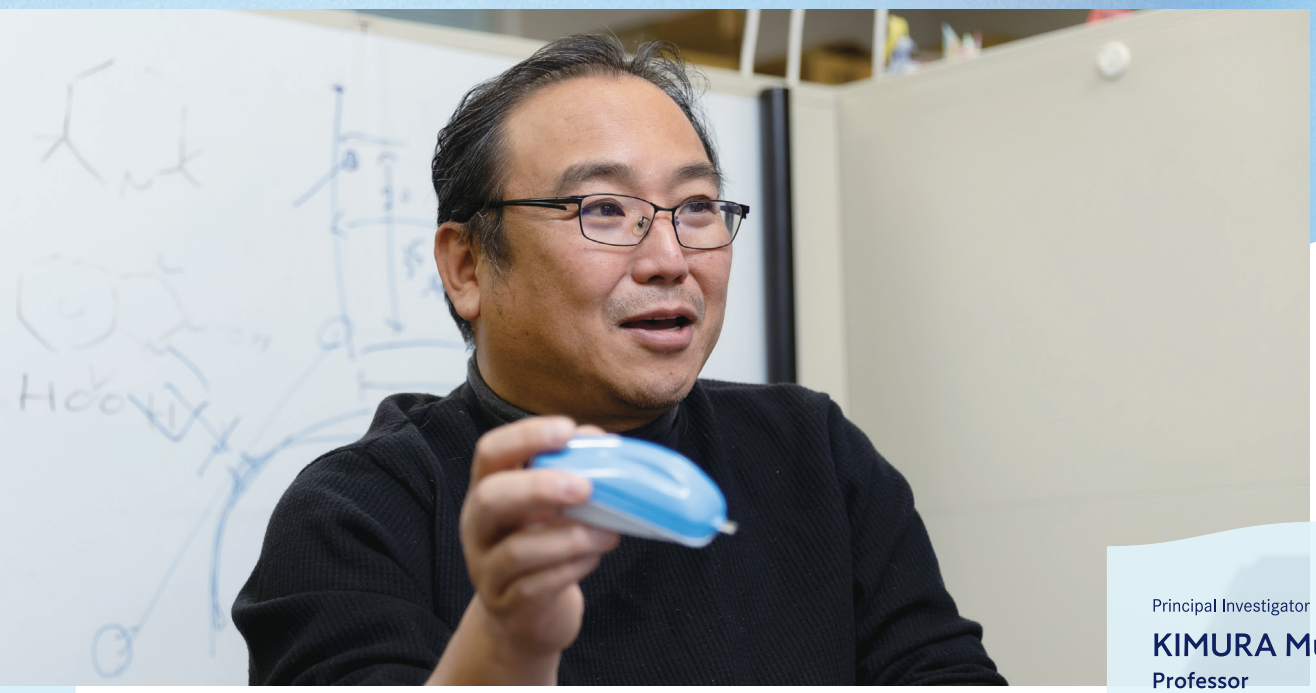

Principal Investigator (PI)
KIMURA Mutsumi
Professor

Developing Novel Functional Materials to Solve Environmental Issues in the Water and Fashion Industries

Water Contamination in Tanzania: Detecting Fluoride levels with MOF

In our lab, we are primarily using organic chemistry techniques to develop functional materials to help clean the environment or reduce ecological burdens.
One such initiative is a project that focuses on improving water quality in Tanzania. In the Arusha Region of Tanzania, groundwater is people's primary water source, and in some areas the water is contaminated by fluoride at ten times higher than in Japan. Shinshu University is making efforts to resolve this issue. Our lab, in particular, is developing and promoting sensors to detect fluoride concentration. Our first aim is to help the local people understand the risks by making fluoride concentrations visible.
We use a new porous material called Metal-Organic Framework (MOF) which is made of organic compounds and metal ions in our sensors. Under blacklight, the color of the glow varies depending on the fluoride concentration. We use 3D printing for the sensor's protective housing, making production relatively low-cost and easy. We are also publishing the blueprints and instructions for the sensor online. This is because we want the local community to be able to build the sensor and monitor the fluoride concentration on their own in the future.

Protecting Global Water Resources with Regenerated Cellulose

In addition, our laboratory is working on ways to solve water-related environmental issues linked to the fashion industry. Many clothes are made of cotton. However, cotton cultivation creates issues such as drying up lakes in certain regions because it uses so much water—72 liters for a single T-shirt.
Our lab seeks to contribute to the resolution of these water issues by working on a cotton recycling approach. The main component of cotton is cellulose, and a unique ionic liquid we developed dissolves cotton waste textiles and chemically re-forms the cellulose into fiber. The recovered cellulose provides a sustainable material for artificial turf, food packaging, agricultural film and more. This approach holds the potential to address water-related environmental issues while also reducing our dependence on petroleum-based plastics.

Principal Investigator (PI)
OGAWA Makoto
Professor (Special Appointment)

Developing Functional Nanomaterials Using Water

Water as the Primary Ingredient Safe and Simple Enough to Make in a Kitchen

Scratch it and immerse it in water, and it repairs itself in under a minute. Stretch it, and it changes color from pink to blue.
These are examples of the remarkable functions of the functional materials we have developed, and what makes our research unique is that all of these materials are made using water as a primary ingredient. In materials chemistry, water is generally used as a “solvent,” but we actively incorporate water as a “structural component” of the material itself. Depending on the material, some can consist of more than 90% water.
One of the strengths of our functional materials is how easy they are to produce. First, clay minerals are collected from the mountains, dried, and turned into a powder. Water is then added to create a jelly-like substance, to which biomaterials such as gelatin and chitin are mixed in, producing functional materials with new properties. Once the clay minerals have been collected, no large-scale equipment is required. The materials are low-cost, safe, and simple enough to make even in a kitchen.

Materials Friendly to Both People and the Environment Expanding Applications and Possibilities

There are many advantages to using water as a raw material. Because our materials are petroleum-free, require no hazardous solvents, and can be disposed of safely, they are extremely environmentally friendly. Another notable feature is that it is safe and gentle for the human body. For example, a functional material made from water, clay minerals, and PVA (polyvinyl alcohol) possesses exceptionally high self-healing properties, giving it potential applications in the medical field.
Functional materials made from water, clay minerals, and gelatin are also being considered for food-related applications. Since clay has the ability to absorb lipids, these materials may also offer benefits for maintaining and improving health.
Water-based functional materials that harness the gifts of nature and are gentle on both people and the environment open up a wide range of possibilities!