"I'm Growing Together with the Technological Development of POLYMETAC™"

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Integration of Metals and Resins

Mizue Kuriyagawa, who received her PhD for research in rheology (the study of the flow of matter), is in her fifth year with Mitsui Chemicals. She is an indispensable presence in the company's research and development into POLYMETAC™, a new metal/resin integration technology. "What I enjoy most in research is when hypotheses and results match," she says, always smiling while tirelessly moving forward.

"The other day, when I saw an autumn mackerel sky, I thought how it looked like a metallic surface seen through an electron microscope. I guess it's an occupational disease (laughs)."

Mizue Kuriyagawa, who engages in research and development of POLYMETAC™, has a cheerful laugh. She is said to have a talent for easily switching into and out of work mode, but recalling metallic surfaces from a mackerel sky is surely a sign of her having scrutinized the surfaces of various metals.

POLYMETAC™ is a technology that takes advantage of the properties of metals and resins to bond them into one. Replacing portions of metal components with resin can reduce weight and even enhance design properties. Conversely, making a portion of resin components metal can increase strength. Integrated molding of metals and resins can also reduce the number of components. In other words, POLYMETAC™ is an integration technology that takes the best of the two materials.

Research into POLYMETAC™ formally began in 2013. Kuriyagawa was a member from the beginning. Mitsui Chemicals began research and development in earnest as a part of its components business. It did so under the concepts of "multi-materials" and "integration of metals and resins," which were inspired by discussion of weight reduction when employees conducted hearings with automobile manufacturers.

Working to acquire knowledge of metals

Kuriyagawa worked eagerly to acquire knowledge of metals.

"There are many kinds of aluminum alloys. They differ in chemical composition, and the condition of their surfaces varies with die casting, extrusion material and rolled material."

The principle behind POLYMETAC™ is as follows. Metal is immersed in chemicals to create complex micropores on its surface. Resin is injected into the micropores in the metal surface, achieving high bonding strength through an anchoring effect in the resin as it works into the metal. While various methods exist for metal/resin integration technologies, the company selected the method of chemical treatment with mass production and handling of complex shapes in mind.

However, soaking metal in chemicals to create micropores that facilitate the anchoring effect was not an easy matter. "The reaction with the chemicals naturally varies with the chemical composition of the metal, but even when the chemical composition is the same, it also varies with the sort of processing method by which the surface was obtained."

Kuriyagawa spent long days in trial and error, working with metal surfaces and crystallization states. "We mainly used aluminum alloys in development, but to enhance our lineup, we're now conducting development with a variety of alloy types."

Integration technology for metals and resins is actually used commonly in smartphone housing. These employ a structure that uses aluminum in the case to evoke a sense of luxury, and resin in parts to let electromagnetic waves through.

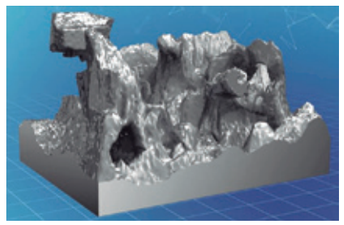
Experimenting in Zambia to reduce weight in unmanned aircraft

The greatest success of POLYMETAC™ has been its adoption in the frame components of autonomous unmanned aerial vehicles (UAVs) from unmanned aircraft developer Aerosense Inc. (Koishikawa, Tokyo). Integrating carbon fiber reinforced plastic (CFRP) parts with aluminum alloy joints enabled the redesign of a joint, initially composed of 20 parts, into a single part, while reducing the joint's weight by 50%.

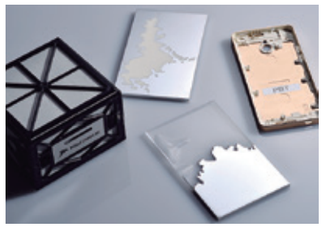
This extended assumed flight distance by 40%. The Japan International Cooperation Agency (JICA) and Aerosense are using the UAVs in experiments to transport medical supplies in Zambia.

In the development of the joints for the UAVs, "We had to make adjustments in design properties while achieving the required strength, which is what required the most time in design," Kuriyagawa recalls. She studied design after joining the company, and gained the ability to draw up plans by learning from others. The ability to perform design matched to customers' needs is a strength of Mitsui Chemicals.

"Together with the growth of POLYMETAC™, I've also grown as a member of the company," says Kuriyagawa, who dreams of a future in which this technology further blossoms.



Integrated molding of an aluminum alloys joint and three CFRP structural material parts (left). Previously, these had been connected using screws, bushing, and other parts, with the components numbering 20. Above is an image of a metal surface after immersing in chemicals. Resin enters into the complex micropores and bonds tightly.



A box that can be easily assembled from a metal sheet (photo, left side) and smartphone housing prototypes. The merits of mass production through integrated molding include weight reduction, high bonding strength, and the improvement of design properties.

Aiming for higher performance as well as weight reduction and simplification

The adoption of POLYMETAC™ in the housing of home appliances and electronic devices is anticipated, and the technology is expected to see application within the next few years in automotive parts like door, seat and control components. In addition to weight reduction through partial use of resins, improvement of design properties, simplification through reduction in the number of components, and improvement of assembly processes through integration of metals and resins, the technology appears to be of use in areas that enhance performance, such as heat radiation and air tightness.