

**Starting Joint Research to Produce Novel Carbon Composite Materials  
for Fusion Reactor Divertor**

**—Developing High Heat-resistance and High Heat-conductivity Materials to Replace Tungsten,  
in an Effort towards Fusion Energy Commercialization**

Mitsubishi Chemical Corporation (Head Office: Chiyoda-ku, Tokyo; President: Manabu Chikumoto; hereinafter “MCC”) has initiated a joint research project (hereinafter the “Joint Research”) in partnership with University of Tsukuba (President: Kyosuke Nagata; hereinafter “Tsukuba Univ.”) and Tokyo University of Science (President: Masatoshi Ishikawa; hereinafter “TUS”) to produce novel carbon composite materials to be used for the divertor, a critical in-vessel component of fusion reactors. The Joint Research covers a range of themes related to development, evaluation and demonstration and social implementation.

**1. Background and purpose**

Nuclear fusion power generation, which is often referred to as creating “a sun on the Earth,” aims to achieve a next-generation clean energy source. This field is attracting growing attention around the world, and many governments are accelerating technology development efforts aimed at commercialization. A fusion reactor is composed of a large number of critical devices, including a divertor. This component is used under extreme conditions due to a particularly high concentration of heat and ash from fusion plasmas, thus being required to have excellent heat resistance and heat extraction (heat conductivity) properties to be able to serve its purpose in such a hostile environment.

Currently, ITER (International Thermonuclear Experimental Reactor) is planned to adopt a tungsten divertor, however, this poses an issue related to a lack of resistance to heat and the impact of plasma that could compromise continuous operation. This is giving rise to calls for developing alternative materials with higher heat resistance and conductivity. Also, given the high dependence on imported tungsten, development of alternatives is considered important to ensure stable supply of materials in the future.

**2. Novel carbon composite materials**

Conventional carbon composite materials exhibit a high degree of heat resistance and heat conductivity when heated in excess of 1000°C, representing a major advantage of these materials for various industrial purposes. The Joint Research aims to create novel substances by adopting carbon composite materials as a base and impregnating high melting-point metals so as to achieve very high heat resistance, specifically to temperatures of 2000°C and above, as well as high heat conductivity while providing appropriate plasma-proof performance, in a bid to meet requirements for use as a material of divertors.

The Joint Research is considering the possibility of broadening the scope of application of the new materials beyond fusion reactors to the heat shielding of space shuttles and supersonic aircraft, with an eye to producing innovative materials originating in Japan and covering fusion and space\*.

**3. Areas of responsibility**

Organization	Area	Details
MCC	Development of carbon composite materials	Develop carbon composite materials capable of high heat conductivity
Tsukuba Univ.	Evaluation of materials	Evaluate the plasma-proof performance of new carbon composite materials
TUS	Selection and development of impregnation metals	Selection of impregnation metals and creation of metal bodies to be impregnated into base materials

Going forward, MCC will continue to work on offering solutions to social issues and contribute to realizing a sustainable society through developing innovative materials.

\* For Reference “The 41st Space Symposium” in Colorado, U.S.”

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