PIM tungsten Langmuir probes tested in nuclear fusion project

The EUROfusion project is a Europe-wide consortium established in 2014 to find the most efficient way of realising fusion electricity by 2050. One of the research projects currently underway is 'Tungsten (W) Environment in Steady State Tokamak' (or WEST) which is intended to become one of EUROfusion's test benches for tungsten components under conditions to be found in the International Thermonuclear Experimental Reactor (ITER). One application envisaged for tungsten is for small Langmuir probes, which are required to deliver precise data such as temperature, density and electric potential from a harsh fusion environment.

The diagnostic Langmuir probes need to survive high power and steady state particle bombardment inside tokamaks without being a risk for machine operation in the event of damage. Not only will the diagnostics provide essential data, the use of tungsten Langmuir probes bolted onto an actively cooled divertor target is considered to be a technical solution suitable for the ITER divertor probe system. As a result, the feedback from the tungsten probes in WEST research is expected to provide input into the ITER design decision.

A recent report published in *Fusion in Europe* (No. 2, 2016) states that WEST researchers were at first struggling to find a technical solution to design the Langmuir tungsten probes, which are about the size of a paper clip. However, collaboration between two European research centres at the Institute of Applied Materials, Karlsruhe Institute of Technology's (KIT), Germany, and the Department de Recherches sur la Fusion at CEA in Cadarache, France, resulted in Powder Injection Moulding (PIM) being used at KIT to produce 70 Langmuir tungsten probes for the tokamak WEST project.

Steffen Antusch, from the Institute of Applied Materials at KIT, stated in the report that the PIM Langmuir probes, which are 25 mm long, 17 mm tall and only 2 mm deep (Fig. 2) had to be produced to strict tolerances in order to comply with the diagnostic requirements of the probes. Producing the small PIM diagnostic probes proved difficult but not impossible thanks to KIT's long standing experience in tungsten PIM. The effort was supported by two industrial partners, Rodinger Kunstoff-Technik GmbH, Germany, which produced the tools for the Powder Injection Moulding of the green moulded parts and Plansee SE, Austria, which specialises in processing refractory metals and high performance materials, finalised the components for WEST.

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Fig. 1 The ITER site under construction in October 2016 (Photo ITER Organisation/EJF Riche)

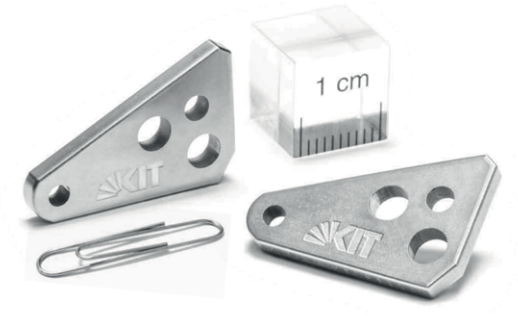

Fig. 2 PIM tungsten Langmuir probes have to deliver precise data from a harsh environment

