



Many fusion research facilities around the world use radiation sensors from Fraunhofer IMM.«

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Stefan Schmitt  
Head of Group Special Sensor Technology  
Fon: +49 6131 990-326  
stefan.schmitt@imm.fraunhofer.de

Fraunhofer Institute for Microengineering and Microsystems IMM  
Carl-Zeiss-Strasse 18-20  
55129 Mainz | Germany  
www.imm.fraunhofer.de



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Radiation measurement based on silicon MEMS

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Radiation hard  
bolometers

# Radiation hard bolometers for nuclear fusion research

In the past few years the development of fusion technology has gained an unprecedented momentum, which is reflected in the large number of newly established commercial enterprises.

For the technological approach of magnetic plasma confinement, Fraunhofer IMM develops and manufactures bolometer chips, which form the core of bolometer cameras used to monitor the plasma in a reactor vessel.

## Application scenario

One of the most prominent projects in which the Fraunhofer IMM is involved is the International Thermonuclear Experimental Reactor (ITER), a nuclear fusion reactor currently under construction. The bolometer chips will be used to measure the intensity of the photon spectrum emitted by the ITER plasma, which ranges from infrared to hard x-rays.

The measurement process was developed by the Max Planck Institute for Plasma Physics (IPP) in Garching and is already in use in a number of national and international facilities. In addition, the measurement of plasma intensity also serves to

## Benefit

Support of fusion research with robust and long-term stable bolometer sensors that are manufactured to high quality standards.



determine the energy balance of the system – in other words, the important question is how much of the energy is obtained from fusion.

## Development work

For each of these high-tech systems, particular challenges have to be overcome: the material must be highly radiation-resistant, the detectors must withstand neutron bombardment and high temperatures of up to 450°C. This always requires a special customization to the specifications of the customers. Based on this, we develop the respective quality requirements together with our customers and implement them.

These tasks are fulfilled in Fraunhofer IMM's 750 m<sup>2</sup> clean room which is equipped with a complete MEMS line. The most important steps in manufacturing the bolometers are:

- coating of the SiN membrane material by means of LPCVD
- coating and structuring of the resistor meander by sputtering and vapor deposition coating
- etching of the pits by KOH
- electroplating of the gold absorber
- dicing, cleaning, final inspection