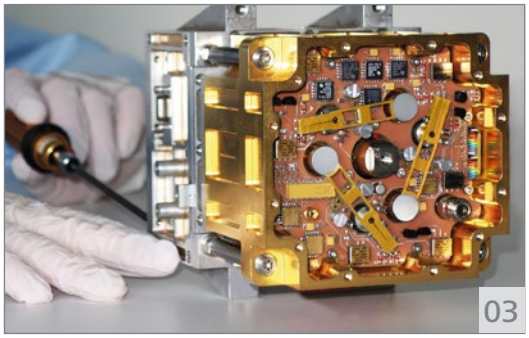
TELSONIC
ULTRASONICS

Tracking the sun

Ultrasonic welding connection for use in space

PLASTIC WELDING | METAL WELDING | CUTTING | CLEANING | SCREENING



Bronschhofen (CH), 04/2018

Our planet's climate is shaped by a complex interplay between the absorption and reflection of solar radiation. An important variable in this is Total Solar Irradiance (TSI), which exhibits variations based on sun activity and in this way could ideally even contribute to slowing down global warming. To record this variability, the «Compact Lightweight Absolute Radiometer» (CLARA) has been journeying through space since mid-August 2017 on board the Norwegian microsatellite NorSat-1 (Figure 4). Torsional ultrasonic welding technology made an important contribution to its manufacture.

The new type of CLARA radiometer CLARA (Figure 3) was developed by the Physikalisch-Meteorologisches Observatorium in Davos (PMOD/WRC). With a weight of only around 2.2 kg, it is exceptionally small and light, but can measure the integrated radiation across the entire spectral range with high precision in the parts-per-thousand range and great long-term stability. It works by recording the temperature difference that arises when the defined heated sensor elements are heated further by the absorbed solar radiation. For this purpose three conical cavities, consisting of a thin-walled, blackened silver carrier, are placed on a thermal resistor. Below this is a heat sink. Its job is to prevent rapid temperature changes for the duration of the measurement cycle.

01 Three conical elements consisting of a 0.13 mm-thick silver carrier, blackened internally and gilded externally, are placed on a thermal resistor.

02 The torsional welding technique, which Telsonic developed and patented, significantly reduces the amount of unwanted vibration transferred to the welding object.

03 The CLARA radiometer was developed by the Physikalisch-Meteorologisches Observatorium in Davos.

04 Norwegian microsatellite NorSat-1

Strict requirements for the joining technology

«To manufacture such a measuring structure, which then detects the slightest variations in TSI under space conditions, poses some difficulties», reports Silvio Koller, electrical engineer and co-director of the technical division of the Physikalisch-Meteorologisches Observatorium Davos. «It was initially difficult to find a suitable joining technology to connect the small 0.13 mm-thick cavities with the thermal resistors.» This connection must be homogenous, easy on material, but at the same time mechanically stable and must guarantee a good thermal contact (Figure 1). «Adhesive technologies were excluded from the start due to poor heat conductivity, and the cavity material was too thin for laser welding,» explains Koller. In earlier projects brazing solder connections were successfully used, but the results of the manual process were difficult to reproduce and therefore also unsatisfactory.

Firm connection technology, but easy on materials

After extensive tests, the choice was finally made for Telsonic's torsional ultrasonic welding technology (Figure 2). The advantage of the torsional method is that the vibrations are introduced into the area surrounding the weld seam only to a small extent. This preserves sensitive components and surfaces and also achieves higher energy densities in the welding range. The result is a firm, mechanically stable connection that can also withstand strong vibrations.
Generally the welding system is arranged vertically. The vibrations are applied tangentially however: the sonotrode moves the upper workpiece horizontally in relation to the lower workpiece. A melt is created between the workpieces through the high vibration frequency of 20 kHz with appropriate amplitude and welding pressure. At the same time the torsional movement of the sonotrode ensures that the area around the welding zone is scarcely impacted by the ultrasonics. The process is therefore especially suitable for sensitive applications such as the CLARA project, where vibrations outside of the welding zone could cause damage. «It also guarantees good heat conductivity, which is also necessary for us, and the quality is reproducible at any time,» says a delighted Koller.
So in the next project, too, which is planned for 2019 with the European Space Agency (ESA), the solar researchers from Davos will also rely on torsional ultrasonic welding technology.

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