SPACE EXPLORATION SYMPOSIUM (A3)
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THE ESA GAIA MISSION; DESIGNING IN SILICON CARBIDE AND RELATED ISSUES

Abstract

TNO is developing the nearly all Silicon Carbide Basic Angle Monitoring Opto-Mechanical Assembly for the GAIA mission of ESA, a space telescope that will create a map of the universe including distant stars and planets. GAIA is being built by EADS Astrium and is scheduled for launch in 2011. The manufacturing of SiC-based structures for space exploration has recently become a focal point of interest within the aerospace industry. Due to its known stability and hardness properties, SiC has been chosen for the payload mirrors and structure of GAIA. The Basic Angle Monitoring subsystem is a metrology system to monitor the angle between the two GAIA telescopes. This system consists of two laser interferometers. Two pairs of parallel laser bundles are sent to the two telescopes, which create two interference patterns on a detector. If the basic angle varies, the interference patterns will shift. With the BAM an Optical Path Difference (OPD) as small as 1.5 picometers RMS can be measured. During the design phase of the Basic Angle Monitoring subsystem, TNO developed solutions for ultra stable mounting of non-SiC optical components to the SiC structure. Amongst them an ultra stable beam splitter mount and a fibre collimator with a Diamond fibre connector interface. Both beam splitter mount and fiber coupler have to withstand launch with preservation of the alignment and retain optical properties from ambient to 100 K in vacuum. Unique combinations of mechanical design principles and manufacturing processes resulted in a spring loaded Fused Silica beam splitter design and a reflective fibre collimator with strongly curved off axis SiC mirror. The manufacturing of off-axis SiC mirrors of the Basic Angle Monitoring down to nm-level represented another challenge. Limited knowledge exists with respect to metrology techniques, and iterative material removal processes, which ultimately yield the required accurate surface shape and roughness. A comprehensive program was conducted on these two aspects of SiC manufacturing for freeform optics and CVD (Chemical Vapor Deposition) coated samples. Status: as all above activities have been concluded successfully the Basic Angle Monitoring has past the Critical Design Review.