STRAY-LIGHT REDUCTION OF SILICON PARTICLE REINFORCED ALUMINUM FOR OPTICAL SYSTEMS

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ABSTRACT

For earth-observation satellites, many optical systems such as spectrometers are based on reflective optics. These can for instance be realized by ultra-precision manufacturing of aluminium based materials in combination with a polished layer of amorphous nickel-phosphorus alloy (NiP) [1]. Applications based on this technology are suitable for visible and near infrared spectral range.

Silicon particle reinforced aluminium with a silicon content of approximately 40 % (AlSi40) and NiP show coefficients of thermal expansion with a difference of lower than 0.5 ppm K⁻¹ [2]. Athermal metal mirrors made of this material combination are thus perfectly suited for application environments differing from room temperature [3]. Ensuring an athermal performance of the entire optical system, the necessary housing is made of the same material combination, NiP coated AlSi40 [4]. In order to avoid ghost images and stray light in optical system, non-reflective surfaces are usually coated with a black coating [5]. However, there is no coating for AlSi40 established, that significantly reduces stray light.

The paper describes fundamental results of different techniques to reduce stray light from AlSi40 surfaces. Typical surface modifications (e.g. anodizing) lead to a non-sufficient optical stray light suppression, because of the high amount of silicon particles on the surface. Therefore, a coating technique is required which fulfills the optical and the mechanical (e.g. adhesive strength) specifications for stray light reduction on AlSi40. Different components, like housings and barrels made of AlSi40 were coated with amorphous NiP and subsequently coated with Magic Black™ by Acktar Ltd. The optical performance is analysed using angle-resolved light scattering (ARS) measurements at different wavelengths (532 nm and 1064 nm). Magic Black™ shows a total scattering level of lower than 1 % at 532 nm and 1064 nm. It is shown, that Magic Black™ is a suitable coating for components made of AlSi40.

REFERENCES