DEVELOPMENT OF AN OPTICAL BLACK COATING FOR SPACE APPLICATION

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ABSTRACT

The space environment is particularly harsh for the materials due to large temperature range, irradiation exposition and vacuum environment. Some specific and critical functions of the satellites are assumed by optical instruments (star trackers, earth observation...) and are the most important function of the satellite. The specifications for the materials used in such devices are more stringent compared to general satellites specifications.

In those specific instruments, optical coatings are used to reach the technical performance required. Several solutions exist on the market and are composed of surface treatment, vacuum deposit or organic coating such as paint. Each solution presents advantages and drawbacks. One of the most used coatings for these applications is the PNC paint. In order to combine the advantages of each solution in one, we have decided to develop a specific product. This paper lists the existing technologies focusing on the drawbacks and advantages of each solution on the market with a specific focus on PNC paint. In a second part we present the ongoing project on this optical coating development. The performance of the PNC paint is a TIS of 3.14%. The total integrated scatter (TIS) is obtained by a BRDF (Bidirectional Reflectance Distribution Function) measurement and is the main characteristic of an optical coating. By the work performed on the pigment, we have obtained interesting coatings with a TIS as low as 1.9 %. The results are presented on the graph hereunder: red curve is the PNC one and blue curve is the modified coating. Results can be observed either on solar absorptivity or TIS.

Moreover, process change has been introduced in order to decrease outgassing rate. The new coating shows a great improvement of the RML (divided by a factor 2) and anymore CVCM, which is a critical property in order to maintain ultralow clean optics parts.

<table>
<thead>
<tr>
<th>System</th>
<th>TML</th>
<th>RML</th>
<th>CVCM</th>
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</thead>
<tbody>
<tr>
<td>PNC</td>
<td>0.63%</td>
<td>0.56%</td>
<td>0.09%</td>
</tr>
<tr>
<td>New coating</td>
<td>0.39 %</td>
<td>0.31%</td>
<td>0.00%</td>
</tr>
</tbody>
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Finally, a new coating with improved properties compared to PNC has been developed.