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Atomic Layer Deposition of Semiconductor Oxides on Electric Sail Tethers

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Abstract

This study shows that thin coating layers of semiconductor oxides, deposited by atomic layer deposition, can be successfully used to improve the performance of tethers used in space technology. Thin layers of ZnO, TiO_2 and Ti-Zn mixed oxide with 25 to 100 nm thickness were considered, and compared with native Al_2O_3 as reference. For this purpose, morphological, optical and electrochemical characterization was performed. As a result, deposited materials show very good adhesion and conformality. Coatings act as anti reflective layers, increasing the absorbance of tethers. The presence of TiO_2 thin layers and mixed oxide improves the corrosion resistance of tethers both in dark and under UV illumination conditions. Our results show that TiO_2 has the best performance for space tether application followed by the mixed oxide.

Keywords: ALD, tether, TiO_2, ZnO, mixed oxides.

Introduction

The hoytether is a device used in space technology to perform attitude manoeuvres and re-entry operations, to create propulsion, or to generate energy [1]. In practice, the hoytether is a conducting wire that interacts with the surrounding plasma when a potential difference is applied to it. The hoytether taken into consideration in this study is the one developed in the frame of the "Electric sail propulsion technology" (ESAIL) project (FP7 project number 262733) as a propellantless thrust generating system [2-5]. The peculiar feature of this technology is to use many Km-long electrically charged wires, which gain momentum from the electrons of the