Wear and degradation analysis of light management nanofabricated layers

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The growing global energy demand and crescent search for fossil fuel independence has prompted the development of sustainable energy sources [1]. Photovoltaic technology stands out as a promising solution to meet this demand, with increasingly thinner solutions being developed in an attempt to reduce not only its production costs, but also the use of raw materials. In that sense, light management techniques have been seen as a successful strategy to improve the light absorption of ultrathin solar cells [2]. One of these strategies consist on adding nanoscale texturization on the front contact of solar cells, enabling an omnidirectional low reflection of light. This texturization corresponds to silicon nanopillars, referred to as moth-eye, an arrangement which has proved to produce the desired anti-reflection effect, minimizing the scattering of light. During its lifetime, the nanoscale architectures will be exposed to environmental stresses, as well as mechanical loads, which can decrease its performance. Thus, incorporating tribological testing into the evaluation of these structures is a valuable approach to ensure that optical and mechanical requirements are achieved [3]. Therefore, this study aims to evaluate the tribomechanical properties of moth-eye structures obtained through nanoimprint lithography, with tests being conducted under specific conditions in laboratorial context. These tests have shown that the predominant wear mechanism is self-polishing (micro-abrasion), and that higher loads result in a higher friction coefficient, for both lower and higher cycle tests. These conclusions provide useful insights into the nanostructure's durability, contributing to the exploration of innovative applications in the field of photovoltaics.

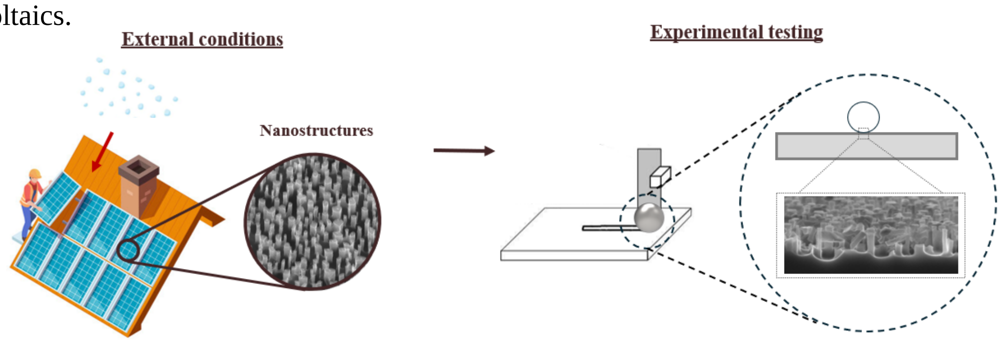

Figure 1 – Tribological characterization of the silicon moth-eye nanostructures in laboratorial context: experimentally simulated contact

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