Anti-Corrosive Protection of Aircrafts unstainable Coatings Based on Biomass Waste: Local Lignin Valorization for high Technology

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The aerospace industry faces major challenges related to the corrosion of metallic alloys, particularly aluminum Al2024, widely used in aircraft structures for its low weight and high mechanical strength.[1] However, its high corrosion susceptibility compromises long-term structural integrity. Traditional protective coatings often use chromate-based compounds, now heavily restricted due to their toxicity and regulations like REACH. This scenario drives the search for sustainable, efficient surface protection technologies aligned with industrial requirement.[2]

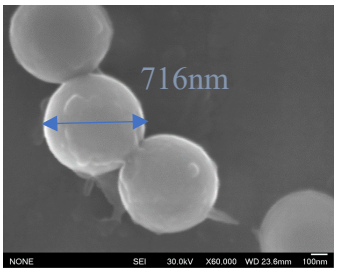

Fig. 1: SiO_2@Lignine Core–shell nanoparticles

In this context, lignin-an aromatic biopolymer derived from paper industry waste-has emerged as a promising raw material for anticorrosive formulations. This work presents the development of lignin-based core–shell nanoparticles (as shown in Figure 1), consisting of a silica (SiO_2) core and a lignin shell, synthesized *via* nanoprecipitation. These nanoparticles were deposited onto Al2024 aluminum substrates using dip coating through the evaporation-induced self-assembly (EISA) technique, forming a uniform and functional coating. [3] The applied coating is supposed to have both some mechanical specificities (provided by the silica) and a certain hydrophobicity (provided by the lignin). Scanning electron microscopy (SEM) revealed a continuous and nanorough film, while X-ray photoelectron spectroscopy (XPS) confirmed the successful deposition and chemical integration. Atomic force microscopy (AFM) measurements quantified nanoscale roughness induced by the coating. These preliminary results demonstrate the potential of lignin-based hybrid nanoparticles as active agents in eco-friendly coatings, supporting the transition to greener corrosion protection technologies in the aerospace sector.

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