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Novel atmospheric pressure plasma technology for nanostructured surfaces

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Nanostructured surfaces are highly suitable for structural bonding processes. The adhesion is determined by the mechanical and chemical anchoring of the adhesive. Especially for aircraft applications nanostructured and modified surfaces can be applied for titanium alloys (Ti_6Al_4V, $Ti_{15}V_3Cr_3Sn_3Al$) and carbon fiber reinforced plastics (CFRP). To enhance their adhesion, both materials are treated with the LARGE (long arc generator) plasma technology. The LARGE plasma source is based on an extended DC arc and offers a scalable working width of up to 350mm. It operates with a wide range of plasma gases such as Ar, H_2, O_2, CO_2, N_2 or compressed air. Due to the very long afterglow plasma, sheet working distances of up to 60mm are possible. The paper will present a new atmospheric pressure plasma technology for the deposition of nanostructured SiO_2 adhesion layers on titanium alloys. The method is suitable for the treatment of large and shaped parts at flexible working distances. For high adhesion values, the layer growing densely starts on the titanium surface. Subsequently an open-pored layer structure results a strong mechanical interaction of the adhesive. In addition, a chemical anchorage of the adhesive is affected by the incorporation of methyl groups into the matrix layer. Due to these two adhesion mechanisms, a significantly better adhesion for thicknesses of between 50 nm and 150 nm and working distances of 2 cm to 6 cm are achieved.
Further the paper will discuss an atmospheric pressure plasma technology which creates an adhesion promoting surface on CFRP. For an optimal adhesion of the CFRP surface and the epoxy-based glue, the residue of silicon from the release agent will be respectively removed convertly in an adhesion promotion layer by the plasma process. Due to this transformation it is possible to enhance the adhesion in comparison to a mechanical cleaned surface.

Keywords
atmospheric plasma source
titan
CFRP
SiO2 adhesion layer