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SURF / Plasma - surface interactions

Plasma surface activation of CFRP substrate to enhance adhesion of PVD/PECVD coatings

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Abstract content

Polymer composites materials such as Carbon Fibres Reinforced Polymer (CFRP) are increasingly employed in aircraft industry as replacement of metallic components because of their higher specific resistance. In order to increase the durability of these materials, it could be interesting to deposit metallic or ceramic thin films. PVD and PECVD processes can be considered to coat thermally sensitive substrate. But, adhesion of such films is known to be low on polymer substrates [1].

Surface pre-treatments are therefore required to improve the adhesion of coatings on CFRP substrate. Nowadays, it is commonly accepted that the enhancement of the adhesion of a coating is related to the density of nucleation sites at the polymer surface [2-3]. In order to get films with the highest level of adhesion, plasma treatment have to be optimized for the chemical composition of the substrate. Surface energy measurements can then be used to quantify the surface activation.

In this way, the purpose of this work is to study the effect of low pressure Ar and N_2 plasmas on the surface energy of CFRP. Various plasma conditions are tested by changing parameters like partial gas pressure, gas mixture and bias voltage. These measurements are complemented by chemical analysis (XPS, FTIR) and surface morphology observations (Profilometer, SEM) to clarify the involved mechanisms.

Finally, the best conditions for plasma activation are tested previous the deposition by magnetron sputtering of pure titanium thin film . The resulting adhesion evaluated using scratch test and pull-off test methods, is improved thanks to plasma activation.

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References

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