PLATHINIUM
PLASMA THIN FILM INTERNATIONAL UNION MEETING
13-17 September 2021
VIRTUAL MEETING
WWW.PLATHINIUM.COM

#PLATH00137
SURF / Plasma - surface interactions

Atmospheric pressure plasma for surface engineering applications

A. Bishop[1], Z. Huang[1], C. Giusca[1], A. Bennett[2], M. Castelli[2,3,4], J. Nicholls[1]
[1] *Cranfield Univ. (UK)*
[2] *Cranfield Plasma Solutions (UK)*
[3] *The Manufacturing Technology Centre (MTC), Coventry (UK)*
[4] *Univ. College Dublin (IE)*

Abstract content

Plasma processing allows extremely accurate alterations of a substrate and is widely used when manufacturing transistors for computer chips[1, 2] and precise lenses[3, 4], however very limited results have been published for the atmospheric plasma etching of metals. Current techniques such as: laser modification, vacuum plasma etching, CVD/PVD (Chemical/Physical Vapour Deposition), SPDT (Single Point Diamond Turning) or Electrolysis based methods all have drawbacks when processing high value metal parts, such as: high running costs, expensive tool replacements, long processing times or involve the use of harmful chemicals. We report here the development of an atmospheric pressure plasma technique for the fast, cost-effective finishing of metal surfaces. Atmospheric reactive atom plasma(RAP) has previously shown good results with optical (Si based) materials, providing nanometre roughness and form accuracy over large areas[5]. Extending this approach to metal parts provides new challenges to the chemistry and physics involved. Using two different plasma systems, a number of compounds and their mixtures have been investigated as reactive species for plasma etching of Ti64 (Ti-6Al-4V) plates. The initial results demonstrate volatile products are formed and can be removed from the surface. Combining various characterisation techniques, the underlying surface chemistry and physics are explored. Initial work shows promising results for a number of applications such as finishing of turbine blades for aerospace engines

References

[1] D. Borah et al., “Plasma etch technologies for the development of ultra-small feature size transistor devices,”J Phys D: Appl Phys, vol. 44, p. 174012, 2011.
[2] J. Cheng et al., “Nanoscale etching of perovskite oxides for field effect transistor applications,”J Vac Sci Techol, vol. 38, p. 012201, 2020.
[3] H. Lee et al., “Fabrication of SiC micro-lens by plasma etching,”Thin Solid Films,vol. 475, p. 318, 2005.
[4] C. Lee et al., “Etching and micro-optics fabrication in diamond using chlorine-based inductively-coupled plasma,”Diam Relat Mater, vol. 17, p. 2192, 2008.
[5] M. Castelli, "Advances in optical figuring by reactive atom plasma (RAP)", PhD thesis,Cranfield University, 2013.