ONE-STEP MODIFICATION OF SPACE INTEGRATED SURFACES (OSMOSIS) FOR ADHESIVE PRIMING

Lorcan Byrne[(1)], Kevin Roche[(1)], Kevin McDonnell[(1)], Gary Morgan[(1)], Ismail Adeyemi[(1)], Joe Flanagan [(2)], Kenneth Stanton[(2)], Barry Twomey[(1)]

[(1)] ENBIO Ltd., DCU Alpha Innovation Campus, Glasnevin, Dublin, D11 KXN4, Ireland, (barry.twomey@enbio.eu)

[(2)] School of Mechanical and Materials Engineering, University College Dublin, Dublin, Ireland (joe.flanagan1@ucd.ie)

Introduction

ENBIO have developed a novel, green, ambient temperature blast coating technique known as CoBlast Prime. A co-incident stream of abrasive and coating media simultaneously remove a metal's passivating layer while depositing a primer coating on the newly-exposed reactive metal surface. Previously used to apply a black thermal control coating surface, this process can be utilised to deposit different chemistries and textures.

Materials and Method

In this work, CoBlast was used to apply an adhesive primer surface to 2024 T3 aluminium and Ti6Al4V using a combination of fusion-bond epoxy and a metal-oxide (CoBlast Prime). Selective area coverage can be achieved and all materials used are chromate-free and REACH-compliant.

To determine the adhesion-promotion benefits of these CoBlast coatings, lap shear testing (ASTM D 1002) was conducted and samples were compared against commercial, State-of-the-Art (SoA) adhesive primers. Samples were prepared using a 2-part epoxy adhesive (3M™ Scotch-Weld™ EC-2216 B/A Grey) and Redux 312 film adhesive. Samples were characterised using surface profilometry, SEM, EDX and cross-sectional microscopy. Bond strengths were determined for:

1. As-bonded samples
2. Samples exposed to 1-week salt fog per ASTM B 117
3. Samples subjected to 1-week humidity aging (56°C, 70% RH)

Similar testing was undertaken on honeycomb sandwich panels (see Fig 2 and 3) in accordance with ASTM D 1781 climbing drum peel test. CoBlast panels were compared against CAA+Redux112 treated and Bare Aluminium.

Results

CoBlast Prime surfaces were shown to achieve equivalent bonded tensile strength to commercially available SoA solutions for both 2-part epoxy and film adhesive systems (Fig. 1). Significantly higher lap-shear strengths were achieved on Ti6Al4V substrates, indicated in Fig 1 (right side).

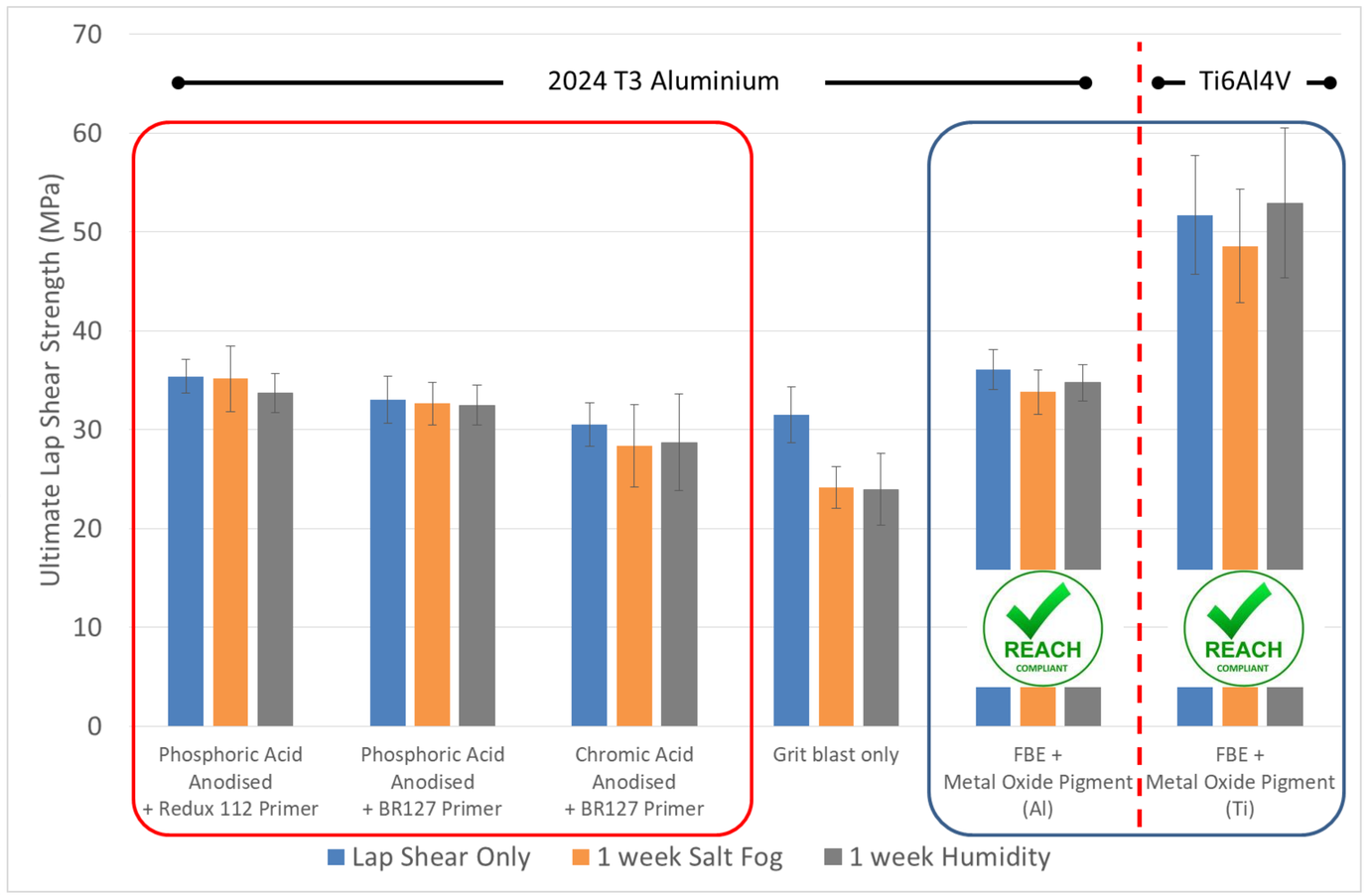

Fig 1: Lap-shear strength comparison for SoA and CoBlast on Aluminium and Titanium

These higher strengths are due to the increased stiffness of the titanium over aluminium and further testing is ongoing to assess against a SoA surface treatment on titanium. Cohesive failure was observed in samples subjected to each ageing regime.

Initial results from honeycomb panel testing demonstrates that the CoBlast surface is compatible with assembly. Storage and salt-fog testing will be completed in the coming months.

Conclusions

A unique feature of the CoBlast Prime process is its ability to treat a range of metals without changing the process or coating materials. Successful adhesion is demonstrated by the cohesive failure of the adhesive. Similar results have been achieved on 5000 and 6000 series aluminium. CoBlast Prime moved the locus of failure from the metal surface (interfacial), into the adhesive (cohesive). As a result, it is compatible with Metal-to-CFRP systems where the metal surface bond is the weaker of the two.

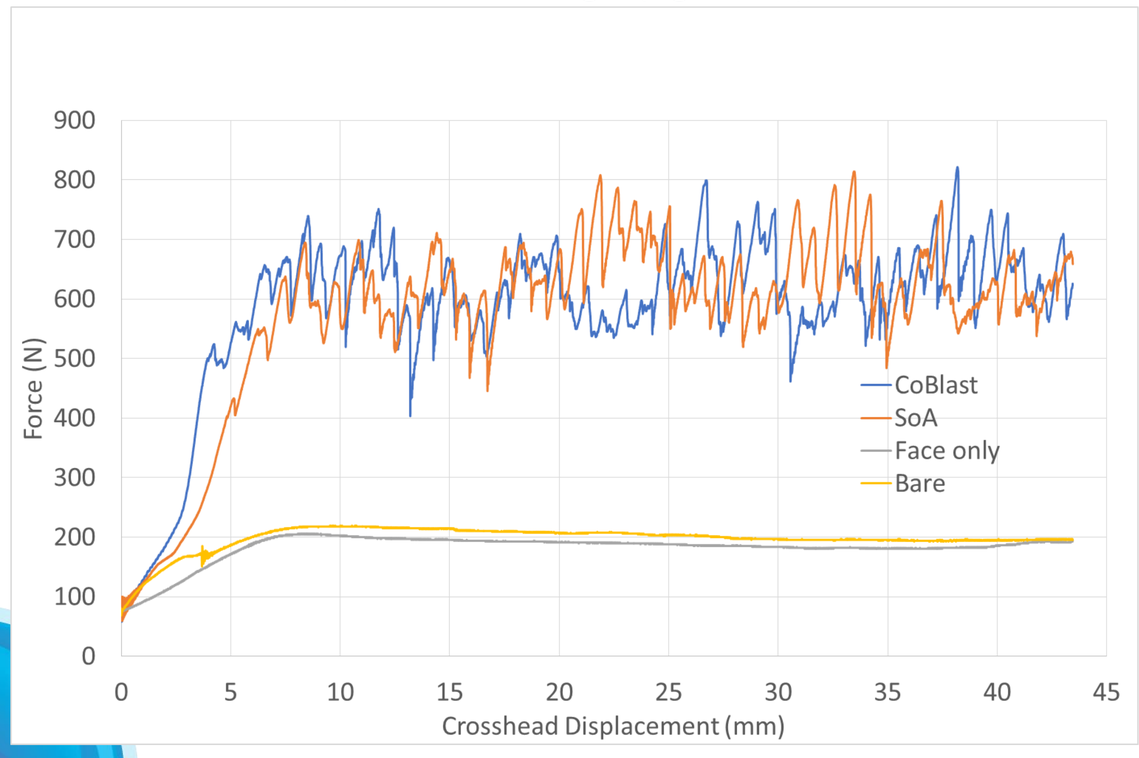

Fig 2: Load profile of honey-comb panel test

	Average (N)	Std. Dev (N)
SoA (CAA+Redux 112)	639.25	63.00
CoBlast (FBE+metal oxide)	626.92	59.63
Untreated face-plate	200.65	5.98
Face-plate only	187.12	4.60

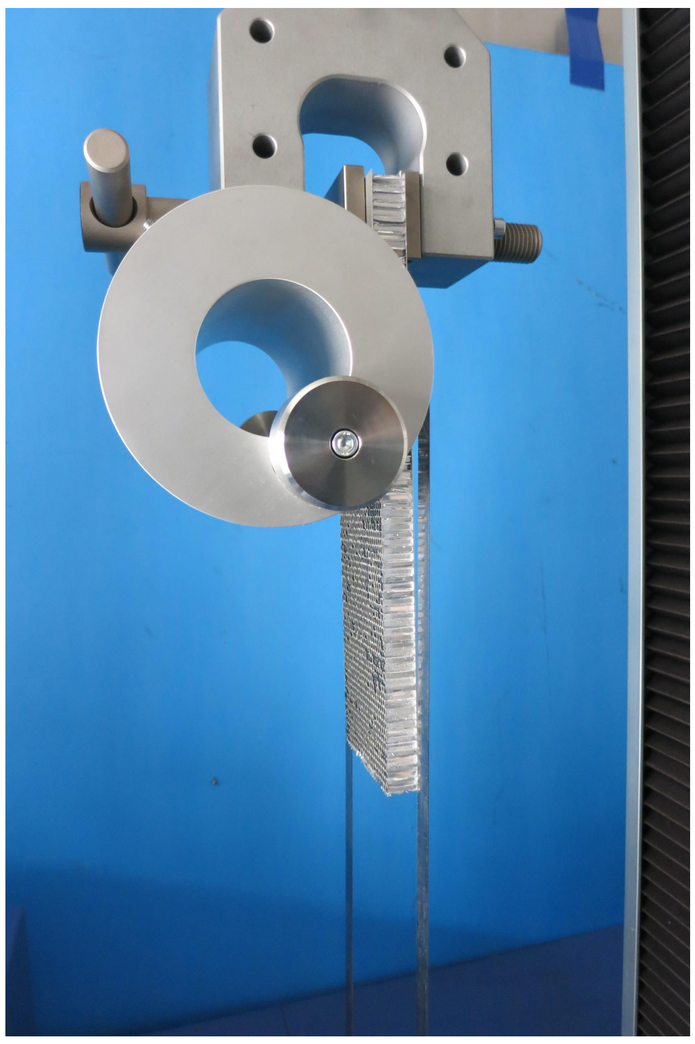

Fig 3: Climbing drum peel-test rig

Future work:

- Extended storage testing for both treated and bonded surfaces (up to 12 months planned)
- Undertake outgassing and thermal cycling testing in line with ECSS requirements
- Validate results against SoA on titanium

Interested in Trialling CoBlast?

ENBIO are interested in getting this surface into the hands of the European Space Community. If you are interested in a trial, please contact us at info@enbio.eu

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 757088