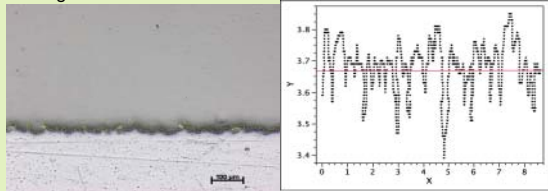


## Microstructure examination of cold gas dynamic spray (CGDS) Ti powder deposits

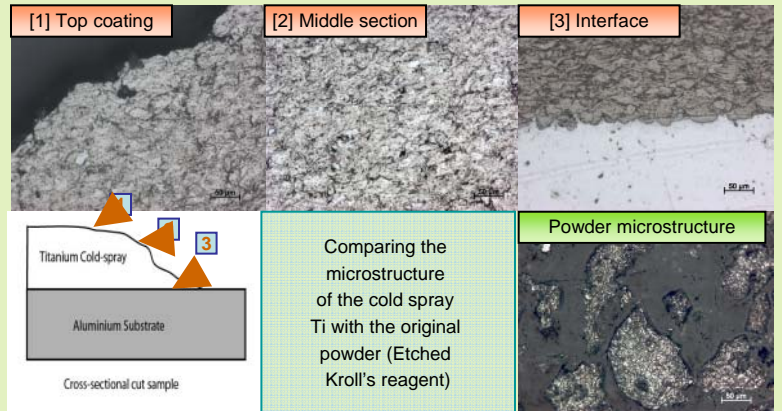
Charles Moy, Mahnaz Jahedi, Gianluca Ranzi and Simon Ringer

### Aim and Objectives

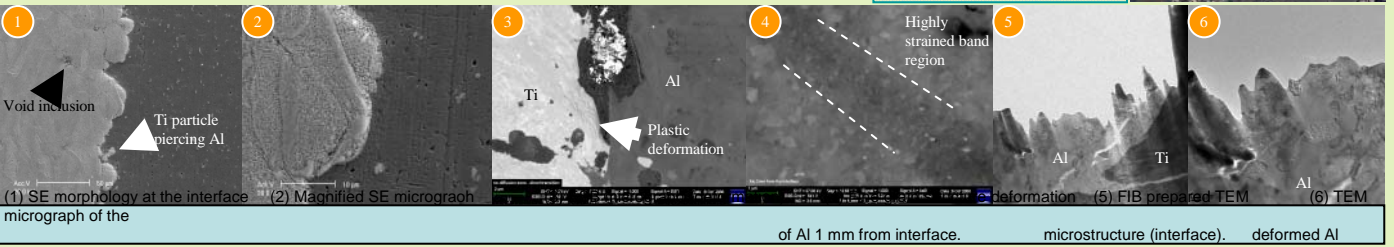
- Examine the microstructure of the cold sprayed Ti and its bonding properties.
- Analyse the composition change across the Ti cross-section.
- Investigate the material property variations through hardness values using nanoindentation test.



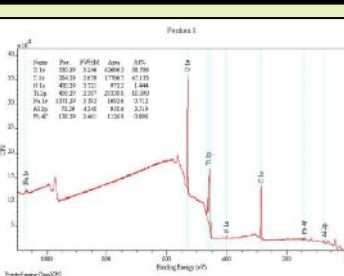
Surface roughness calculated by applying a bivariate fit along the cross-sectional interface yielding a root mean square of 7.65 μm



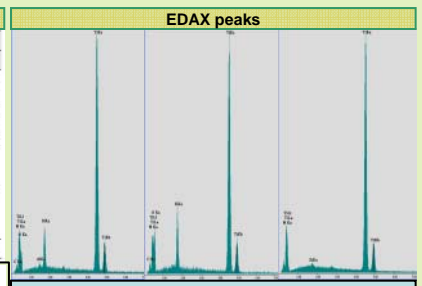
Comparing the microstructure of the cold spray Ti with the original powder (Etched Kroll's reagent)



(1) SE morphology at the interface (2) Magnified SE micrograph of the interface (3) SE morphology at the interface (4) SEM micrograph of Al 1 mm from interface. (5) FIB prepared TEM microstructure (interface). (6) TEM micrograph of deformed Al

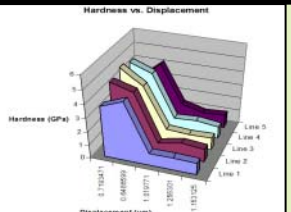
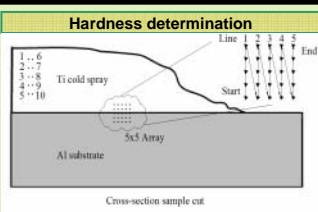
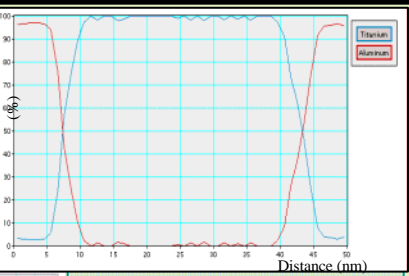
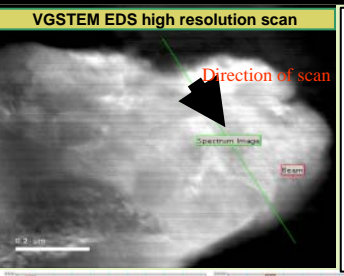
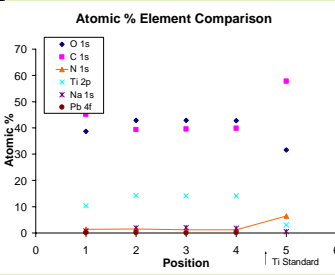
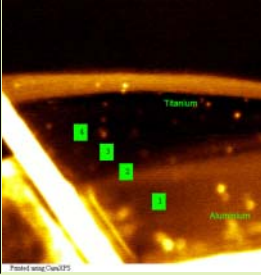
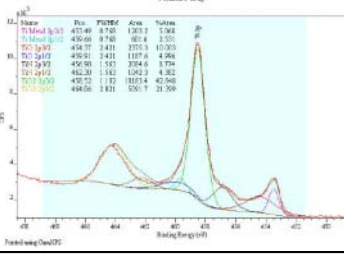


	At %				% Area			
	Pos. 1	Pos. 2	Pos. 3	Pos. 4	CP Ti Plate	Powder 1	Powder 2	Powder 3
O 1s	38.708	42.863	42.904	42.774	31.844	49.237	48.092	52.084
C 1s	45.133	39.305	39.534	39.894	57.767	36.422	35.098	33.630
N 1s	1.444	1.485	1.130	1.168	6.408	0.000	0.000	0.000
Ti 2p	10.390	14.295	14.179	14.135	3.057	8.807	10.286	11.335
Na 1s	0.712	1.964	2.048	1.770	0.488			
Al 2p	3.519							
Ca 2p			0.171	0.139		1.047	1.096	0.388
Pb 4f	0.096	0.089	0.034	0.119				
Si 2p					0.637	1.062		
	100.000	100.001	100.000	99.999	100.001	96.575	94.542	97.337



Element	Region I			Region II			Region III		
	Wt. %	At. %	K-Ratio	Wt. %	At. %	K-Ratio	Wt. %	At. %	K-Ratio
NK	0.50	1.70	0.0026	0.64	2.14	0.0033	0.71	2.37	0.0037
SiK	0.45	0.76	0.0032	0.47	0.78	0.0033	0.53	0.88	0.0038
TiK	99.04	97.54	0.9884	98.89	97.08	0.9866	98.77	96.75	0.9851
Total	100	100		100	100		100	100	

The XPS and EDAX detect the presence of Nitrogen ions in the cold spray Ti but is absent in the original Ti powder.



	0.72	0.65	1.02	1.26	1.15
Line 1	3.774731887	4.395499443	0.927032901	0.933940989	0.893653721
Line 2	4.715680643	4.263466963	0.776879568	1.139176027	0.988676305
Line 3	5.023985727	3.942284389	0.982137428	0.881781639	0.932808744
Line 4	4.733501767	4.141425782	1.006638664	1.111835698	0.91334371
Line 5	2.854023336	4.157691215	1.336547671	0.892151757	0.999606735

The EDS and nano-hardness indicate a narrow transition region at the interface

### Conclusion

- SEM and TEM showed gross plastic particle deformation near the interfacial region.
- Compositional analysis (XPS & EDAX) provide evidence of Nitrogen pick-up.
- EDS performed using the VGSTEM revealed a maximum inter-diffusion region of about 5 nm.

### Acknowledgement:

The author would like to thank his co-supervisors Prof. Simon Ringer and Dr. Gianluca Ranzi for their help and support. In addition, the financial support from the CSIRO is gratefully acknowledged.