11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Characterization of PTA Fe-Al coatings processed on different substrate steels

G. D. Bazzi[(1)*], A. S. C. M. d'Oliveira[((2)]

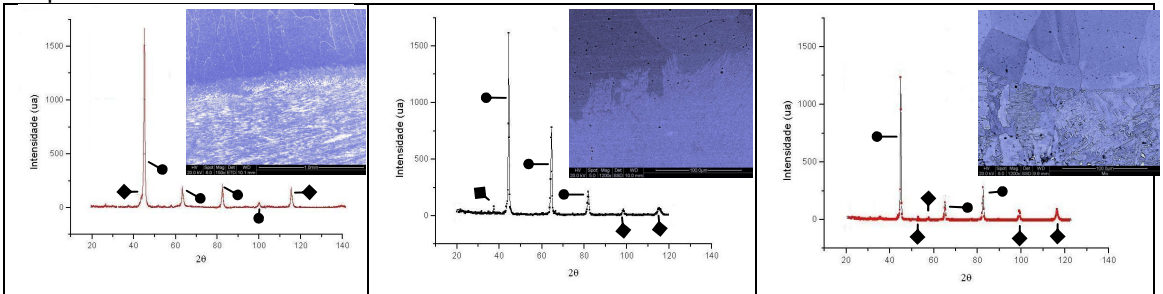
(1) PG-Mec/ Universidade Federal do Paraná, Centro Politécnico, Cx P. 19011,Curitiba/PR, 81 531 999, Brazil, gessica_dias@yahoo.com.br.
(2) Mechanical engineering department/ Universidade Federal do Paraná, Centro Politécnico, Cx P. 19011,Curitiba/PR, 81 531 999, Brazil,sofmat@ufpr.br.
* Corresponding author.

Abstract – In-situ development of Fe-Al coatings during the deposition of Fe and Al powder mixtures is a major step to tailor components to attend demands imposed by aggressive service conditions. The interaction between the deposited mixture and the substrate steels was evaluated. Results showed that this interaction plays a major role on properties of the coatings much more significant than observed following the deposition of superalloys coatings.

The attractive high temperature properties of structural Fe-Al intermetallic alloys have motivated their development as coatings for the protection of mechanical components operating under aggressive service conditions. Particularly, coatings that have to act as a protective barrier and also as a sacrificial material impose a processing challenge as the required thickness can only be obtained by a welding process. Among these, Plasma transferred arc hardfacing is a leading technique for the processing of high quality hard coatings [1]. Powder mixtures can be processed allowing for the in-situ development of coatings within a wide range of chemical composition and properties. The understanding the contribution of the features of substrate material to the developing coating is a key issue for the control of processing. This study aimed at identifying the influence of the chemical composition of the substrate steel on the in-situ development of Fe-Al coatings processed with a powder mixture containing Fe and 15wt%Al (28at%Al). The Fe-Al powder mixtures were deposited on AISI1020, AISI304 and AISI316 steel plates using the same set of processing parameters.

X-ray diffraction of the processed coatings revealed that FeAl and Fe_3Al were developed during deposition regardless of the chemical composition of the substrate, figure 1. Nevertheless, the features of the coatings differ significantly depending on the substrate used. Compared to superalloy coatings the processed coatings exhibited a very large dilution, over 40%, which was associated with exothermal synthesis of the aluminide phases [2] that increase the temperature at the solidification front. The mixture of the deposited Fe-Al powder mixtures with the substrate were larger for those processed on the stainless steels, 65% and 75%, which can be related with the lower thermal conductivity of the substrate. The diffusion of alloying elements into the coatings influenced their hardness the deposits with the larger dilution exhibited the highest hardness, as solid solution strengthening occurred [3]. The increase on temperature at the solidification front can also be correlated with the developed columnar solidification structure observed in all deposits figure 1.

Results showed that the design of Fe-Al coatings through in-situ processing strongly depends on the interaction between the deposited powder mixtures and the substrate steels in the weld pool during deposition.



FeAl Fe3Al	FeAl Fe3Al	FeAl Fe3Al
Microhardness 467±19 HV dilution: 75%, **Substrate: AISI 316**	Microhardness: 504±17 HV dilution: 65%, **Substrate: AISI 304**	Microhardness: 247 ±17 HV Dilution: 40%; **Substrate: AISI 1020**

References

[1] DAVIS, J. R. , " Hardening Weld cladding and dissimilar metal joining" ASM handbool – Welding, Brazing and Soldering, Vol 06 10th Edition ASM Park Ohio, p69-828, 1993

[2] OZEMIR, O., ZEYTIN,S. , BINDAL, C. " Characterization of two phase nickel aluminides produced by pressure – assisted combustion synthesis" Vaccum, vol 82, issue 3, pg 311-315, 2007.

[3] FLEISCHER, R.L. , DIMIDUK, D. M. , LIPSITT, H.A. " Intermetallic compounds for strong High temperature Materials: Status and Potential." Annual Review of Materials Science, Vol 19 Pg 231-263, 1989