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# INFLUENCE OF MICROSTRUCTURE ON THE HARDNESS BEHAVIOR OF AISI DUPLEX-2205 COMPOSITE LAYER BY TIG CLADDING

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Abstract

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## Abstract

Duplex stainless steel (DSS) material with grade of AISI Duplex-2205 show a decrease performance under aggressive environment which may lead to unanticipated failure due to poor surface properties. Therefore, the surface modification of this material is important to increase the hardness and wear behavior for various applications in the automotive, aerospace and oil and gas industries. The surface

modification using SiC ceramic powder with particle size of 60 µm by TIG torch technique has been developed on the surface of AISI Duplex-2205. The TIG torch was employed at different arc energy of 0.480, 0.768 and 1.440 KJ/mm. The composite surface layer was developed via deposition of ceramic particles into AISI Duplex-2205. Based on the experimental results, it was found that the composite layer attained a maximum hardness of 1245 Hv from substrate hardness of 250 Hv for TIG processed at 0.768 KJ/mm. The cross-sectional view of the melt pool for TIG torch melted processed showed a hemispherical shape due to the Gaussian energy distribution of the torch which has been known to have high energy intensity in the center region and gradually decrease to the boarders of the fluid zone. The microstructure demonstrates the formation of the dendrite microstructure due to the complete fusing and re-solidification of SiC in the composite layer that contributes to the hardness enhancement. The formation of dendrites in the melt pool contributes to the hardness and wear enhancement of AISI Duplex-2205 which can be used for wear and high temperature applications. 

Author keywords

composite layer; duplex-2205; hardness; Microstructure; TIG torch

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References (20)

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1 Ma, M., Sun, W.-C., Zhang, Y.-G., Liu, X.-J., Dong, Y.-R., Zi, J.-Y., Xiao, Y.

Effect of TiC particles concentration on microstructure and properties of Ni-TiC composite coatings

(2019) *Materials Research*, 22 (6), art. no. e20190530. Cited 10 times.
http://www.scielo.br/pdf/mr/v22n6/1516-1439-mr-22-06-e20190530.pdf
doi: 10.1590/1980-5373-MR-2019-0530

View at Publisher

2 Mo, T., Chen, J., Bai, W., Wu, Y., Zhang, P., Zheng, B.

Ni/TiC composite electrodeposition on the surface of Ni-based superalloy

(2021) *Surface and Coatings Technology*, 424, art. no. 127611. Cited 4 times.
http://www.journals.elsevier.com/surface-and-coatings-technology/
doi: 10.1016/j.surfcoat.2021.127611

View at Publisher

3 Bello, K.A., Maleque, M.A., Adebisi, A.A., Dube, A.

Preparation and characterisation of TIG-alloyed hybrid composite coatings for high-temperature tribological applications

(2016) *Transactions of the Institute of Metal Finishing*, 94 (4), pp. 211-221. Cited 12 times.
http://www.tandfonline.com/loi/ytim20#.VwHcmk1f1Qs
doi: 10.1080/00202967.2016.1182727

View at Publisher

4 Md Idriss, A.N., Mridha, S.

Microstructure of TIG melted composite coating on steel produced using 1.0 and 1.5 mg/mm$^2$ TiC at an energy input of 2640 J/mm

(2012) *Advanced Materials Research*, 576, pp. 467-470. Cited 10 times.
http://www.scientific.net/AMR.576.467
ISBN: 978-303785498-3
doi: 10.4028/www.scientific.net/AMR.576.467

View at Publisher

5 Mestra, A., Fargas, G., Anglada, M., Mateo, A.

Sliding wear behavior of a duplex stainless steel

(2010) *Key Engineering Materials*, 423, pp. 125-130. Cited 6 times.
https://www.scientific.net/KEM
ISBN: 0878493034; 978-087849303-6
doi: 10.4028/www.scientific.net/KEM.423.125

View at Publisher

6 Mourad, A.-H.I., Khourshid, A., Sharef, T.

Gas tungsten arc and laser beam welding processes effects on duplex stainless steel 2205 properties

(2012) *Materials Science and Engineering A*, 549, pp. 105-113. Cited 120 times.
doi: 10.1016/j.msea.2012.04.012

View at Publisher

7 Sahu, A., Raheem, A., Masanta, M., Sahoo, C.K.

On the constancy in wear characteristic of large area TiC–Ni coating developed by overlapping of TIG arc scanning

(2020) *Tribology International*, 151, art. no. 106501. Cited 10 times.
www.elsevier.com/inca/publications/store/3/0/4/7/4
doi: 10.1016/j.triboint.2020.106501

View at Publisher

8 Muñoz-Escalona, P., Mridha, S., Baker, T.N.

Effect of silicon carbide particle size on microstructure and properties of a coating layer on steel produced by TIG technique

(2016) *Advances in Materials and Processing Technologies*, 2 (4), pp. 451-460. Cited 8 times.
tandfonline.com/toc/tmpt20/current
doi: 10.1080/2374068X.2016.1246217

View at Publisher

9 Brytan, Z., Dobrzański, L. A., Pakieła, W.
Laser surface alloying of sintered stainless steels with SiC powder
(2011) *Journal of Achievements in Materials and Manufacturing Engineering*, 47, pp. 42-56. Cited 22 times.

10 Paraye, N.K., Ghosh, P.K., Das, S.

Surface modification via in situ formation of titanium carbide in ferrous matrix through TIG arcing

(2021) *Materials Letters*, 283, art. no. 128723. Cited 6 times.
http://www.journals.elsevier.com/materials-letters/
doi: 10.1016/j.matlet.2020.128723

View at Publisher

11 PADHEE, C.K., MASANTA, M., MONDAL, A.K.

Feasibility of Al–TiC coating on AZ91 magnesium alloy by TIG alloying method for tribological application

(2020) *Transactions of Nonferrous Metals Society of China (English Edition)*, 30 (6), pp. 1550-1559. Cited 10 times.
https://www.journals.elsevier.com/transactions-of-nonferrous-metals-society-of-china
doi: 10.1016/S1003-6326(20)65318-3

View at Publisher

12 Maleque, M. A., Adeleke, S. A.
Surface alloying of CP-Ti using preplaced Fe-C-Si powder by tungsten inert gas torch technique
(2013) *International Conference on Mechanical, Industrial and Materials Engineering 2013 (ICMIME2013)*. Cited 6 times.
Rajshahi, Bangladesh, 1-3 November 2013

13 Maleque, M.A., Bello, K.A., Adebisi, A.A., Akma, N.

Optimization of tribological performance of SiC embedded composite coating via Taguchi analysis approach

(2017) *IOP Conference Series: Materials Science and Engineering*, 184 (1), art. no. 012035. Cited 7 times.
http://www.iop.org/EJ/journal/mse
doi: 10.1088/1757-899X/184/1/012035

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14 Mridha, S., Dyuti, S.

Effects of processing parameters on microstructures and properties of TIG melted surface layer of steel (Open Access)

(2011) *Advanced Materials Research*, 264-265, pp. 1421-1426. Cited 9 times.
ISBN: 978-303785053-4
doi: 10.4028/www.scientific.net/AMR.264-265.1421

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15 Buytoz, S.

Microstructural properties of SiC based hardfacing on low alloy steel

(2006) *Surface and Coatings Technology*, 200 (12-13), pp. 3734-3742. Cited 52 times.
doi: 10.1016/j.surfcoat.2005.01.106

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16 Zeng, D.W, Xie, C.S, Yung, K.C
Mesostructured composite coating on SAE 1045 carbon steel synthesized in situ by laser surface alloying (Open Access)

(2002) *Materials Letters*, 56 (5), pp. 680-684. Cited 8 times.
doi: 10.1016/S0167-577X(02)00578-5

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17 Bello, K.A., Maleque, M.A., Adebisi, A.A., Dube, A.
Preparation and characterisation of TIG-alloyed hybrid composite coatings for high-temperature tribological applications

(2016) *Transactions of the Institute of Metal Finishing*, 94 (4), pp. 211-221. Cited 12 times.
http://www.tandfonline.com/loi/ytim20#.VwHcmk1f1Qs
doi: 10.1080/00202967.2016.1182727

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18 Wang, X.H., Song, S.L., Qu, S.Y., Zou, Z.D.
Characterization of in situ synthesized TiC particle reinforced Fe-based composite coatings produced by multi-pass overlapping GTAW melting process (Open Access)

(2007) *Surface and Coatings Technology*, 201 (12), pp. 5899-5905. Cited 86 times.
doi: 10.1016/j.surfcoat.2006.10.042

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19 Mridha, S., Baker, T.N.
Overlapping tracks processed by TIG melting TIC preplaced powder on low alloy steel surfaces

(2015) *Materials Science and Technology (United Kingdom)*, 31 (3), pp. 337-343. Cited 30 times.
http://www.maneyonline.com/doi/pdfplus/10.1179/1743284714Y.0000000530
doi: 10.1179/1743284714Y.0000000530

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20 Adeleke, S. A., Maleque, M. A.
TIG melted surface modified titanium alloy for cylinder liner application
(2015) *International Journal of Automotive Engineering and Technologies*, 4 (3), pp. 130-138. Cited 8 times.

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