Scopus

Documents

Maleque, M.A.[a] , Idriss, A.N.M.[a] , Naping, R.[a] , Rahman, M.M.[b] , Efeoglu, I.[c]

The Influence of TiC Dispersion and Density on the Microstructural Features and Microhardness Fused by TIG Arc Process

(2024) *Journal of Advanced Research in Applied Mechanics*, 114 (1), pp. 33-42.

DOI: 10.37934/aram.114.1.3342

[a] Department of Manufacturing and Materials Engineering, Kulliyah of Engineering, International Islamic University of Malaysia, PO Box 10, Kuala Lumpur, 50728, Malaysia
[b] College of Engineering, Universiti Malaysia Pahang, Pahang26300, Malaysia
[c] Faculty of Engineering, Department of Mechanical Engineering, Atatürk University, Erzurum, 25240, Turkey

Abstract
Surface hardening is a technique to modify a thin layer on the substrate serving the purpose to resist annihilation from the wear and corrosion conditions. In this work titanium carbide (TiC) particulates was incorporated on the surface of the AISI 4340 low alloy steel at different content and heat inputs using the tungsten inert gas (TIG) melting process. The examined melt sizes, microstructures, defects and microhardness were reported. It was found that all tracks were free from crack defects with each track possessing sound metallurgical bonding to the substrate. The containment of majority undissolved TiC followed by the reprecipitated ones were densed when melting was conducted at 2160 J/mm between 1mg/mm2 to 2 mg/mm2 powder. The reprecipitated mostly the globular and flower type microstructures were seen dispersed and surrounded by overwhelmingly more of the Fe matrix fused at 1008 J/mm between 0.4 mg/mm2 to 0.5 mg/mm2. The arc was constricted to allow extensive dissolution when higher 1 mg/mm2 to 2 mg/mm2 powder were used and so dissolution and reprecipitation was poor. The populated undissolved TiC above 1 mg/mm2 deemed for the demarcation hardness trends which were evident by sudden dropped from above 1400 HV to ~ 900 HV and rised back to 1050 HV. Dissolution of substrate and particulates were enhanced with higher heat input associated with lower powder content.

Author Keywords
Preplace; Steel; TiC; TIG arc

References

- Candela, C.Sánchez de Rojas, Riquelme, Ainhoa, Rodrigo, Pilar, Torres, Belén., Rams, Joaquin
  Wear behaviour of additively manufactured 316L/SiCp composites with up to 60 wt% SiCp
  (2022) *Ceramic International*, 48 (22), pp. 33736-33750.

- Bedolla-Becerril, Egberto, Garcia-Guerra, Josefina, Lopez-Morelos, Víctor H., Garcia-Renteria, Marco A., Falcon-Franco, Lazaro A., Martinez-Landeros, Víctor H., García-Villarreal, Sergio, Flores-Villaseñor, Sergio E.
  Tribological Behaviour of Al-2024/TiC Metal Matrix Composites
  (2022) *Coatings*, 13 (1), p. 77.

- Li, Chonggui, Li, Shuai, Liu, Chuanming, Zhang, Youfeng, Deng, Peiran, Guo, Yajun, Wang, Jinqian, Wang, You
  Effect of WC addition on microstructure and tribological properties of bimodal aluminum composite coatings fabricated by laser surface alloying
  (2019) *Materials Chemistry and Physics*, 234, pp. 9-15.

- Zorzi, Janete Eunice, Perottoni, Cláudio Antônio, Da Jornada, J. A. H.
  Hardness and wear resistance of B4C ceramics prepared with several additives
  (2005) *Materials Letters*, 59 (23), pp. 2932-2935.

- Ren, Yiqun, Li, Liqun, Zhou, Yuandong, Wang, Shuliang
  In situ synthesized VC reinforced Fe-based coating by using extreme high-speed

laser cladding
(2022) *Materials Letters*, 315, p. 131962.

- Debta, Malaya Kumar, Masanta, Manoj
  Effect of stand-off-distance on the performance of TIG cladded TiC-Co coating deposited on Ti-6Al-4V alloy
  (2022) *Surface and Coatings Technology*, 434, p. 128210.

- Kalpakjian, Serope, Schmid, Steven R.
  Manufacturing Engineering and Technology, p. 123.
  5th edition, Prentice Hall

- Shahbudin, Siti Nurshahmira Ahmad, Amin, Sri Yulis M., Othman, Mohd Hilmi, Ibrahim, Mohd Halim Irwan
  Study on Properties of Heat-treated WC-6Co with Different Wt.% of TiC Powder
  (2020) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 66 (2), pp. 168-178.

- Idriss, Ahmed Nazrin Md, Kasolang, Salmiah, Maleque, M. A., Nasir, Ramdziah Md, Tebal, Nibong
  An overview on the importance of surface modification by TIG and lasers incorporating carbides and their relations to wear behaviours
  (2021) *Jurnal Tribologi*, 29, pp. 96-116.

- Ayers, J. D.
  Wear behavior of carbide-injected titanium and aluminum alloys
  (1984) *Wear*, 97 (3), pp. 249-266.

- Lusquiños, F., Comesaña, R., Riveiro, A., Quintero, F., Pou, J.
  Fibre laser micro-cladding of Co-based alloys on stainless steel
  (2009) *Surface and Coatings Technology*, 203 (14), pp. 1933-1940.

- Dyuti, Sarker, Mridha, S., Shaha, S. K.
  Wear behavior of modified surface layer produced by TIG melting of preplaced Ti powder in nitrogen environment
  (2011) *Advanced Materials Research*, 264, pp. 1427-1432.

- Kirchgaßner, M., Badisch, E., Franek, F.
  Behaviour of iron-based hardfacing alloys under abrasion and impact
  (2008) *Wear*, 265 (5-6), pp. 772-779.

- Wang, X. H., Song, S. L., Zou, Z. D., Qu, S. Y.
  Fabricating TiC particles reinforced Fe-based composite coatings produced by GTAW multi-layers melting process
  (2006) *Materials Science and Engineering: A*, 441 (1-2), pp. 60-67.

- Emamian, Ali, Corbin, Stephen F., Khajepour, Amir
  The influence of combined laser parameters on in-situ formed TiC morphology during laser cladding
  (2011) *Surface and Coatings Technology*, 206 (1), pp. 124-131.

- Idriss, AN Md, Maleque, M. A., Afiq, A.
  Synthetization of TiC surface hardening using TIG melting technique-The effect of working distance."
  (2022) *In IOP Conference Series: Materials Science and Engineering*, 1244 (1), p. 012012.

- Mridha, Shahjahan, Baker, T. N.
  Overlapping tracks processed by TIG melting TiC preplaced powder on low alloy steel surfaces
  (2015) *Materials Science and Technology*, 31 (3), pp. 337-343.

- Toozandehjani, M., Ostovan, F., Shafiei, E., Jamaludin, K. R., Amrin, A., Hasanzadeh, E.
  Surface treatment of Al7075 Matrix by TiC particles via hybrid ball milling and tungsten inert gas cladding
  (2020) *Metall Ital*, 2020, pp. 21-30.

- Chang, Chia-Ming, Chen, Yen-Chun, Wu, Weite
  Microstructural and abrasive characteristics of high carbon Fe– Cr–C hardfacing alloy
  (2010) *Tribology international*, 43 (5-6), pp. 929-934.

- Idriss, AN Md, Kasolang, S., Maleque, M. A.
  Demographic Changes by the Vickers Microhardness Surface Indentations on the TiC Metal Matrix Composite TIG Melted Track
  (2020) *Proceedings of the Malaysian International Tribology Conference*, pp. 230-235.

- Easterling, K.E.
  (1995) *Chapter 1-Introduction to the Physical Metallurgy of Welding*, Butterworth-Heinemann, London

- Salleh, Muhammad Naqiuddin Mat, Ishak, Mahadzir, Yamasaki, Kazuhiko, Quazi, Moinuddin Mohammed, Halil, Aiman Mohd
  Pulsed Nd: YAG laser parameters effect on welding uncoated advance high strength steel (AHSS) for automotive
  (2021) *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, 84 (1), pp. 91-100.

- Li, Chonggui, Li, Shuai, Liu, Chuanming, Zhang, Youfeng, Deng, Peiran, Guo, Yajun, Wang, Jinqian, Wang, You
  Effect of WC addition on microstructure and tribological properties of bimodal aluminum composite coatings fabricated by laser surface alloying
  (2019) *Materials Chemistry and Physics*, 234, pp. 9-15.

- Amuda, M. O. H., Lawal, T. F., Daramola, O., Awarun, A. B. W. O.
  Wear and corrosion characteristics of silicon carbide surface modified mild steel
  (2018) *UNILAG Journal of Medicine, Science and Technology*, 6 (1), pp. 129-146.

- Abboud, J. H., West, D. R. F.
  Microstructure of titanium injected with SiC particles by laser processing
  (1991) *Journal of Materials Science Letters*, 10 (19), pp. 1149-1152.

- Mridha, S., Baker, T. N.
  Incorporation of 3 μm SiCp into Titanium surfaces using a 2.8 kW laser beam of 186 and 373 MJ m− 2 energy densities in a nitrogen environment
  (2007) *Journal of materials processing technology*, 185 (1-3), pp. 38-45.

- Mridha, Shahjahan, Idriss, AN Md, Baker, T. N.
  Incorporation of TiC particulates on AISI 4340 low alloy steel surfaces via tungsten inert gas arc melting
  (2012) *Advanced Materials Research*, 445, pp. 655-660.

- Muñoz-Escalona, P., Mridha, Shahjahan, Baker, T. N.
  Effect of shielding gas on the properties and microstructure of melted steel surface using a TIG torch
  (2015) *Advances in Materials and Processing Technologies*, 1 (3-4), pp. 435-443.

- Das, Mitun, Bysakh, Sandip, Basu, Debabrata, Sampath Kumar, TS, Balla, Vamsi Krishna, Bose, Susmita, Bandyopadhyay, Amit
  Microstructure, mechanical and wear properties of laser processed SiC particle reinforced coatings on titanium
  (2011) *Surface and Coatings Technology*, 205 (19), pp. 4366-4373.

Correspondence Address
Maleque M.A.; Department of Manufacturing and Materials Engineering, PO Box 10, Malaysia; email: maleque@iium.edu.my

Publisher: Semarak Ilmu Publishing

ISSN: 22897895
Language of Original Document: English
Abbreviated Source Title: J. Adv. Res. Appl. Mech.
2-s2.0-85186630717
Document Type: Article
Publication Stage: Final
Source: Scopus