Lecture Notes in Mechanical Engineering • Pages 229 - 236 • 2023 • 5th International Conference on Advances in Manufacturing and Materials Engineering, ICAMME 2022 • KualaLumpur • 9 August 2022through 10 August 2022 • Code 294689

Document type
Conference Paper

Source type
Book Series

ISSN
21954356

ISBN
978-981199508-8

DOI
10.1007/978-981-19-9509-5_31

Publisher
Springer Science and Business Media Deutschland GmbH

Original language
English

Volume Editors
Maleque M.A., Ahmad Azhar A.Z., Sarifuddin N., Syed Shaharuddin S.I., Mohd Ali A., Abdul Halim N.F.

View less

Enhancing the Tool Life of Aluminium Oxide (Al_2O_3) Inserts Using Hybrid Microwave Energy in Dry Machining of High Strength Steel (KRUPP 6582)

Alawbali, Rakan Hatem; Ariff, Tasnim Firdaus

Save all to author list

[a] Department of Manufacturing and Materials Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia

Full text options Export

Abstract

Author keywords

Indexed keywords

SciVal Topics

Abstract

Alumina (Al_2O_3) is a high-performance ceramic material with outstanding physical properties. Alumina is regarded as an extremely hard material with excellent wear resistance. However, tool wear remains a severe issue of dry machining resulting in a reduction in tool life, increased tool cost and a higher frequency of tool changing. Therefore, in this study, Hybrid Microwave (HMW) energy is employed to improve mechanical properties and extend tool life. Three different types of Alumina inserts were used. Al_2O_3 (HMW) was post-sintered with silicon carbide (SiC) as the susceptor, whereas Al_2O_3 (MW) was post-sintered with no susceptor. These two inserts were compared to the original sample Al_2O_3 (Untreated). The post-sintering processes lasted 20 min at 220 °C. Mechanical testing, such as density and hardness, was carried out. Dry machining was used to test the tool life and wear resistance of these Alumina inserts at three different cutting speeds (198, 250, and 310 m/min) at a feed rate of 0.2 mm/rev and a depth of cut of 0.2 mm. This study employed a high-strength steel workpiece (KRUPP 6582). When compared to Al_2O_3 (MW) and Al_2O_3 (untreated) inserts, the results showed that the density and hardness of Alumina inserts were increased using the HMW post-sintering procedure by 3.6% and 6.3% respectively. The tool life of Al_2O_3 (HMW) has increased by 28%, while for Al_2O_3 (MW), only 8.8%. HMW has demonstrated good performance in enhancing the mechanical properties and tool life of Al_2O_3 in dry machining of high strength steel (KRUPP 6582). © 2023, The Author(s), under exclusive license to Springer Nature Singapore Pte Ltd.

Author keywords

Al_2O_3 ; Hybrid microwave; SiC; Tool life

References (13)

1 Goindi, G.S., Sarkar, P.

Dry machining: A step towards sustainable machining – Challenges and future directions

(2017) *Journal of Cleaner Production*, 165, pp. 1557-1571. Cited 188 times.
doi: 10.1016/j.jclepro.2017.07.235

View at Publisher

2 Sun, J., Wang, W., Yue, Q.

Review on microwave-matter interaction fundamentals and efficient microwave-associated heating strategies

(2016) *Materials*, 9 (4), art. no. 231. Cited 361 times.
http://www.mdpi.com/1996-1944/9/4/231/pdf
doi: 10.3390/ma9040231

View at Publisher

3 Karayannis VG (2016) Microwave sintering of ceramic materials
IOP Conf Ser Mater Sci Eng, 161 (1).

4 Yang, G., Park, S.-J.

Conventional and microwave hydrothermal synthesis and application of functional materials: A review

(2019) *Materials*, 12 (7), art. no. 1177. Cited 221 times.
https://res.mdpi.com/materials/materials-12-01177/article_deploy/materials-12-01177.pdf?filename=&attachment=1
doi: 10.3390/ma12071177

View at Publisher

5 Tayier, W., Janasekaran, S., Tai, V.C.

Microwave hybrid heating (MHH) of Ni-based alloy powder on Ni and steel-based metals –a review on fundamentals and parameters

(2022) *International Journal of Lightweight Materials and Manufacture*, 5 (1), pp. 58-73. Cited 7 times.
www.keaipublishing.com/en/journals/international-journal-of-lightweight-materials-and-manufacture/
doi: 10.1016/j.ijlmm.2021.10.002

View at Publisher

6 Buitrago, E., Schneider, N., Corvasce, C., Vobecky, J., De-Michielis, L., Rahimo, M.

Pushing the Limits of the Maximum Punch-Through Design with an Advanced Buffer for Thin Wafer IGBTs (Open Access)

(2020) *Proceedings of the International Symposium on Power Semiconductor Devices and ICs*, 2020-September, art. no. 9170103, pp. 509-512. Cited 1651 times.
ISBN: 978-172814836-6
doi: 10.1109/ISPSD46842.2020.9170103

View at Publisher

7 Bekal, A., Hebbale, A.M., Srinath, M.S.

Review on Material Processing Through Microwave Energy (Open Access)

(2018) *IOP Conference Series: Materials Science and Engineering*, 376 (1), art. no. 012079. Cited 14 times.
http://www.iop.org/EJ/journal/mse
doi: 10.1088/1757-899X/376/1/012079

View at Publisher

8 Ariff, T.F., Mohamed, N.M.N., Binafif, A.A., Azhar, A.Z., Bahar, R., Karim, A.N.M., Amin, A.K.M.
Improvements in the development of silicon nitride inserts using hybrid microwave energy for machining Inconel 718
(2018) *Int J Eng Res Technol*, 7 (10).

9 Ćurković, L., Veseli, R., Gabelica, I., Žmak, I., Ropuš, I., Vukšić, M.

A review of microwave-assisted sintering technique (Open Access)

(2021) *Transactions of Famena*, 45 (1). Cited 13 times.
https://hrcak.srce.hr/index.php?show=clanak&id_clanak_jezik=373212
doi: 10.21278/TOF.451021220

View at Publisher

10 Marinel, S., Manière, C., Bilot, A., Bilot, C., Harnois, C., Riquet, G., Valdivieso, F., (...), Barthélemy, F.

Microwave sintering of alumina at 915 MHz: Modeling, process control, and microstructure distribution (Open Access)

(2019) *Materials*, 12 (16), art. no. 2544. Cited 10 times.
https://res.mdpi.com/materials/materials-12-02544/article_deploy/materials-12-02544.pdf?filename=&attachment=1
doi: 10.3390/ma12162544

View at Publisher

11 Khalile, N., Petit, C., Meunier, C., Valdivieso, F.

Hybrid microwave sintering of alumina and 3 mol% Y_2O_3-stabilized zirconia in a multimode cavity – Influence of the sintering cell (Open Access)

(2022) *Ceramics International*, 48 (13), pp. 18143-18150. Cited 5 times.
https://www.journals.elsevier.com/ceramics-international
doi: 10.1016/j.ceramint.2022.03.072

View at Publisher

12 Kalpakjian, S., Schmid, S.R.
(2019) *Manufacturing Engineering and Technology*. Cited 2032 times.
8th edn. Pearson Prentice Hall, Singapore

13 Vukšić, M., Ljubek, M., Zmak, I., Ćurković, L.
Hybrid microwave sintering of alumina ceramics which contain waste alumina
(2020) *Nanomaterials Sci Eng*, 2 (4), pp. 154-161. Cited 2 times.

Ariff, T.F.; Department of Manufacturing and Materials Engineering, Faculty of Engineering, International Islamic University Malaysia, Kuala Lumpur, Malaysia; email:tasnim@iium.edu.my

About Scopus

What is Scopus

Content coverage

Scopus blog

Scopus API

Privacy matters

Language

日本語版を表示する

查看简体中文版本

查看繁體中文版本

Просмотр версии на русском языке

Customer Service

Help

Tutorials

Contact us

ELSEVIER