

Ductile Performance of Tempered Alumina Dispersed 5050 Aluminum Alloy Metal Matrix Composites Using RVE Models

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ABSTRACT

Alumina (Al_2O_3) is found as the mineral corundum. It provides superior abrasion, high temperature and chemical resistance, and is also electrically insulating. This material has an excellent cost-to-part life performance record. Purity Applications include wear- and heat-resistant liners, mechanical and pump seals, nozzles, semiconductor equipment components, insulators, etc. AA5050 is famous for its very good corrosion resistance and good workability properties. It is commonly used in the manufacture of refrigerator trim and coiled tubes. The fracture of particle reinforced metal matrix composites is dependent on the particle strength and particle/matrix interface strength.

The present work was focused on the effects of temperaments such as H32, H34, H36 and H38 on the properties of alumina (Al_2O_3) reinforced AA5050 composites. The results obtained from the finite element analysis (FEA) were validated with those of experimentation. The tensile strength and von Mises stress was greatly improved with the temperament, H38.

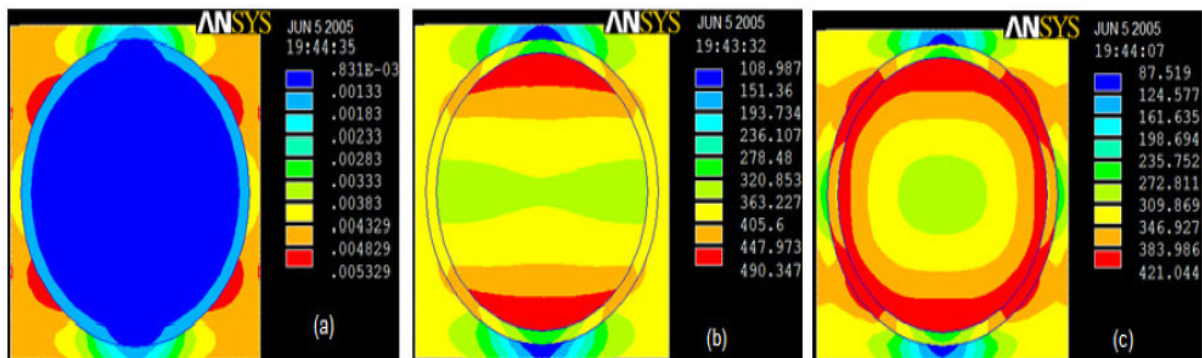


Figure 1: FEA results for heat treatment, T6 (a) tensile strain, (b) tensile strength and (c) von Mises stress.

References

1. A. C. Reddy, Effect of Particle Loading on Microelastic Behavior and interfacial Traction of Boron Carbide/AA4015 Alloy Metal Matrix Composites, 1st International Conference on Composite Materials and Characterization, Bangalore, 14-15 March 1997, pp.176-179.
2. A. C. Reddy, Reckoning of Micro-stresses and interfacial Traction in Titanium Boride/AA2024 Alloy Metal Matrix Composites, 1st International Conference on Composite Materials and Characterization, Bangalore, 14-15 March 1997, pp.195-197.
3. A. C. Reddy, Interfacial Debonding Analysis in Terms of Interfacial Traction for Titanium Boride/AA3003 Alloy Metal Matrix Composites, 1st National Conference on Modern Materials and Manufacturing, Pune, India, 19-20 December 1997, pp.124-127.
4. A. C. Reddy, Evaluation of Debonding and Dislocation Occurrences in Rhombus Silicon Nitride Particulate/AA4015 Alloy Metal Matrix Composites, 1st National Conference on Modern Materials and Manufacturing, Pune, India, 19-20 December 1997, pp.278-282.
5. A. C. Reddy, Assessment of Debonding and Particulate Fracture Occurrences in Circular Silicon Nitride Particulate/AA5050 Alloy Metal Matrix Composites, National Conference on Materials and Manufacturing Processes, Hyderabad, India, 27-28 February 1998, pp.104-109.
6. A. C. Reddy, Local Stress Differential for Particulate Fracture in AA2024/Titanium Carbide Nanoparticulate Metal Matrix Composites, National Conference on Materials and Manufacturing Processes, Hyderabad, India, 27-28 February 1998, pp.127-131.
7. A. C. Reddy, Cohesive Zone Finite Element Analysis to Envisage Interface Debonding in AA7020/Titanium Oxide Nanoparticulate Metal Matrix Composites, 2nd International Conference on Composite Materials and Characterization, Nagpur, India, 9-10 April 1999, pp.204-209.
8. A. C. Reddy, Micromechanical Modelling of Interfacial Debonding in AA1100/Graphite Nanoparticulate Reinforced Metal Matrix Composites, 2nd International Conference on Composite Materials and Characterization, Nagpur, India, 9-10 April 1999, pp.249-253.
9. A. C. Reddy, Micromechanical and fracture behaviors of Ellipsoidal Graphite Reinforced AA2024 Alloy Matrix Composites, 2nd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 10-11 March 2000, pp.96-103.
10. A. C. Reddy, Constitutive Behavior of AA5050/MgO Metal Matrix Composites with Interface Debonding: the Finite Element Method for Uniaxial Tension, 2nd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 10-11 March 2000, pp.121-127.
11. A. C. Reddy, Effect of CTE and Stiffness Mismatches on Interphase and Particle Fractures of Zirconium Carbide/AA5050 Alloy Particle-Reinforced Composites, 3rd International Conference on Composite Materials and Characterization, Chennai, India, 11-12 May 2001, pp.257-262.
12. A. C. Reddy, Behavioral Characteristics of Graphite /AA6061 Alloy Particle-Reinforced Metal Matrix Composites, 3rd International Conference on Composite Materials and Characterization, Chennai, India, 11-12 May 2001, pp.263-269.
13. A. C. Reddy, Prediction of CTE of Al/TiB₂ Metal Matrix Composites, 3rd International Conference on Composite Materials and Characterization, Chennai, India, 11-12 May 2001, pp.270-275.
14. A. C. Reddy, Significance of Testing Parameters on the Wear Behavior of AA1100/B₄C Metal Matrix Composites based on the Taguchi Method, 3rd International Conference on Composite Materials and Characterization, Chennai, India, 11-12 May 2001, pp.276-280.

15. A. C. Reddy, Mechanisms of Load Transfer in Tension to Estimate Interfacial Behaviour of Kevlar 29 / Epoxy Composites by Laser Raman Spectroscopy, National Conference on Advances in Manufacturing Technologies (AMT-2001), Pune, 9-10 March 2001, pp.205-207.
16. A. C. Reddy, Fracture behavior of brittle matrix and alumina trihydrate particulate composites, Indian Journal of Engineering & Materials Sciences, vol. 9, no. 5, pp. 365-368, 2002.
17. A. C. Reddy, Two dimensional (2D) RVE-Based Modeling of Interphase Separation and Particle Fracture in Graphite/5050 Particle Reinforced Composites, 3rd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 22-25 February 2002, pp.179-183.
18. A. C. Reddy, Simulation of MgO/AA6061 Particulate-Reinforced Composites Taking Account of CTE Mismatch Effects and Interphase Separation, 3rd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 22-25 February 2002, pp.184-187.
19. A. C. Reddy, Evaluation of Thermal Expansion of Al/B4C Metal Matrix Composites, 3rd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 22-25 February 2002, pp.196-200.
20. A. C. Reddy, Wear Resistant Titanium Boride Metal Matrix Composites, 3rd National Conference on Materials and Manufacturing Processes, Hyderabad, India, 22-25 February 2002, pp.201-205.
21. A. C. Reddy, Finite Element Analysis Study of Micromechanical Clustering Characteristics of Graphite/AA7020 Alloy Particle Reinforced Composites, 4th International Conference on Composite Materials and Characterization, Hyderabad, India, 7-8 March 2003, pp.206-210.
22. A. C. Reddy, Investigation of the Clustering Behavior of Titanium Diboride Particles in TiB₂/AA2024 Alloy Metal Matrix Composites, 4th International Conference on Composite Materials and Characterization, Hyderabad, India, 7-8 March 2003, pp.216-220.
23. A. C. Reddy, Thermal Expansion Studies on Aluminum Matrix Composites with Different Reinforcement Volume Fractions of Si₃N₄ Nanoparticles, 4th International Conference on Composite Materials and Characterization, Hyderabad, India, 7-8 March 2003, pp.221-225.
24. A. C. Reddy, On the Wear of AA4015 – Fused Silica Metal Matrix Composites, 4th International Conference on Composite Materials and Characterization, Hyderabad, India, 7-8 March 2003, pp.226-230.
25. A. C. Reddy, B. Kotiveerachari, Effect of matrix microstructure and reinforcement fracture on the properties of tempered SiC/Al-alloy composites, National conference on advances in materials and their processing, Bagalkot, 28-29th November 2003, pp.121-124.
26. A. C. Reddy, Finite element analysis of elastic-plastic and tensile damage response in carbon-carbon composites under vehicular crush conditions, National Conference on Emerging Trends in Mechanical Engineering, Nagapur, 05-06th February 2004.
27. A.C. Reddy, Experimental evaluation of elastic lattice strains in the discontinuously SiC reinforced Al-alloy composites, National Conference on Emerging Trends in Mechanical Engineering, Nagapur, 05-06th February 2004.
28. A. C. Reddy, Thermal Expansion Behavior of Aluminum Matrix Composites Reinforced with Fused Quartz Nanoparticles, National Conference on Advanced Materials and Manufacturing Techniques, Hyderabad, 08-09th March 2004, pp. 350-355.

29. A. C. Reddy, Wear Characteristics of AA5050/TiC Metal Matrix Composites, National Conference on Advanced Materials and Manufacturing Techniques, Hyderabad, 08-09th March 2004, 356-360.
30. A. C. Reddy, Analysis of the Relationship Between the Interface Structure and the Strength of Carbon-Aluminum Composites, NATCON-ME, Bangalore, 13-14th March, 2004, 61-62.
31. A. C. Reddy, S. Sundararajan, Influences of ageing, inclusions and voids on the ductile fracture mechanism of commercial Al-alloys, Journal of Bulletin of Material Sciences, vol. 28, no. 1, pp. 101-105, 2005.
32. A. Chennakesava Reddy, Effect of Porosity Formation during Synthesis of Cast AA4015/Titanium Nitride Particle-Metal Matrix Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, 9-10 June 2006, 139-143.
33. A. Chennakesava Reddy, Stir Casting Process on Porosity Development and Micromechanical Properties of AA5050/Titanium Oxide Metal Matrix Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, 9-10 June 2006, 144-148.
34. A. Chennakesava Reddy, Effect of TiC Nanoparticles on the Coefficient of Thermal Expansion Behavior of the Aluminum Metal Matrix Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, 9-10 June 2006, 164-168.
35. A. Chennakesava Reddy, Tribological Behavior of AA8090/MgO Composites, 5th National Conference on Materials and Manufacturing Processes, Hyderabad, 9-10 June 2006, 169-173.