DONALD S. SHIH
Former Distinguished Professor, Kumamoto University, JAPAN
Former Technical Fellow, The Boeing Company, USA
Phone: +886 986 863 815 [in Taiwan]; Email: donaldshih11@gmail.com;

Education

Georgia Institute of Technology	Metallurgy; Ceramics (minor)	PhD (1983)
University of Wisconsin-Milwaukee	Materials Science	MS (1980)
National Cheng Kung University	Metallurgy & MSE	BS (1972)

Appointments & Employments

Kumamoto University, Mg Research Center, Inst of Light Metals — 2017 — 2023
Distinguished Professor

Boeing (and McDonnell Douglas Research Lab). Scientist — 1992 — 2017
Boeing Technical Fellow (Honored in 2008 — 2017)
Adjunct Professor, Southern Illinois University – Edwardsville (2000 — 2003)

GE Aircraft Engines. Lead Engineer — 1986 — 1991

University of Illinois – Urbana, Champaign. Postdoctoral Fellow — 1983 —1986

Expertise and Research Interests; Lectures

- R&D and Transition Methodology in aerospace materials - metallics and non-metallics.
- Integrated Computational Materials Engineering (ICME) for Ti and Mg alloys for aerospace applications: multiscale modeling and simulation, physics-based microstructural modeling linked with crystal plasticity modeling for property prediction and component application. Statistics-based data mining with digital databases integrated with computational and experimental tools. Have had case studies in both Ti and Mg alloys.
- LPSO precipitates in Mg alloys. Advanced Mg alloys with high thermal conductivity, high strength, ductility and high corrosion resistance for multifunctional usages. Biodegradable Mg alloys.

- Lectures **in English** (MS/ PhD levels) — "Physical Metallurgy of Aerospace Materials". Taught for 5 years at Kumamoto University.
- Lectures **in English** (BS level) — "Materials Science & Engineering". Taught for 3 years at Southern Illinois University at Edwardsville.
- Titanium and titanium aluminide alloys and structures: alloy design, development and application. Ultra-fine grained Ti, high-temperature Ti alloys, superplastic forming and diffusion bonding.

- Mg alloy design and process, and application development – Ultrahigh strength Mg alloys with 30% lower density than Al7xxx alloys, but with the strengths of Al7055 for aerospace, auto, and rail applications; nonflammable Mg alloys; die-casting for 3C and wrought processing for transportation applications; “green” applications; thermal management for computers.

- Metallic thermal protection systems – manufacturing, testing, modeling and analysis of titanium and superalloys honeycomb sandwich structures based for hypersonic and supersonic applications. Ultralight and robust sandwich structures are built with thin foils of Ti alloys and superalloys.
- Very high strength Al-Mg-X alloys.
- Ultrahigh strength stainless steels; high specific strength stainless steels.
- Data-mining methodology.

- Structural porous materials, metallic foams, cellular materials and their sandwich structures for multifunctional applications; *e.g.* structural & thermal management, structural & sensing, crashworthy: Ti foams, Al foams, Ti *in situ* low-density core sandwich structures, Cu foams.
- Nacelle thermal insulation technology: thermal blanket, integrated design for thermal management
- Hydrogen in metals; Hydrogen embrittlement in Ti alloys, superalloys and steels: hydrogen – dislocation interactions, hydrogen storage.

- **HELP (Hydrogen Enhanced Localized Plasticity) theory and mechanism in metallics.**

Noteworthy Honors and Awards

- Japan Science & Technology Agency: “Development of Advanced Magnesium Alloys for Multifunctional Applications in Extreme Environments,” Nov 2022 — Nov 2024 (36 months).
- JSPS grant/ award (Japan): Collaborative research grant with South Korea on light metals, 2022.
- NSF Award: Microstructure-Sensitive Design of Multiphase Structural Alloys. http://www.nsf.gov/awardsearch/showAward?AWD_ID=1333083 Aug 2013 – Jul 2017.

- Invited Distinguished Keynote Speaker at the “Aerospace Industry and New Materials in Next Generation” Symposium in Kumamoto, Japan, April 2013.
- Invited Keynote Speaker at the TMS Annual Meeting, Orlando, FL, February 2012.
- Invited Keynote Speaker at the TMS Annual Meeting, San Diego, CA, March 2011.

- More than US$14M of contracts/ grants captured for the past 20 years from DARPA [cellular materials], AFRL, and ONR.
- Inducted and honored as Boeing Technical Fellow, 2008
- Boeing Pride Award, 2007 - outstanding performance in winning 2 external programs

- Two Boeing Pride Achievement Awards, 2006 – for gaining a key technology transfer
- Boeing Pride Achievement Award, 2002 & 2004 – for leading proposal/ win to NASA
- Outstanding Scholar, Midwest Chinese American Science & Technology Association, 2001.

- Boeing Leading Edge Award, 1998
- Materials Research Society Award, 1998
- Invited speaker in the top 40 gamma-TiAl technology scientist in a workshop in Germany, 1994 – GKSS Forschungszentrum Geesthacht, invited 40 top scientists in the world in titanium aluminides to an expense-paid workshop in Kloster Irsee, Germany.
- McDonnell Douglas Teammate of Distinction Award, 1993
- GE Superior Achievement Award, 1988.

Most Selected Products Closely Related to My Research Interests

More than 50 papers published, one book edited, more than 20 U.S. government technical reports completed, over 100 oral presentations made, three (3) U.S. patent granted (on gamma-TiAl Ti aluminides and Al-Mg-Ca-X alloys). More than US$14M of contracts/ awards captured.

https://scholar.google.com/citations?hl=en&user=IheftRYAAAAJ&view_op=list_works

The selected ones include:

1. Chang-Yang Hsieh, Shih-Yen Huang, Yu-Ren Chu, Hung-Wei Yen, Hsin-Chih Lin, **Donald S Shih**, Yoshihito Kawamura, Yueh-Lien Lee, "Role of second phases in the corrosion resistance and cerium conversion coating treatment of as-extruded Mg–8Al–4Ca magnesium alloy", Volume 22, 2343-2359, 2023.
2. Yoshihito Kawamura, Kazuki Ougi, Shin-ichi Inoue, Takanori Kiguchi, Makoto Takafuji, Hirotaka Ihara, **Donald S Shih**, "Advanced Mg–Al–Ca Alloys with Combined Properties of High Thermal Conductivity, High Mechanical Strength and Non-Flammability", Materials transactions, Vol 63 Issue 2, 118-127, 2022.
3. **Shih, D.S.,** Wilson, P.N., Kim, S-K., Kim, B-H. and Yoon, Y-O., "Aluminum alloy with additions of magnesium and at least one of chromium, manganese and zirconium, and method of manufacturing the same", US Patent 11149332B2, Oct 19, 2021.
4. **Shih, D.S.,** Wilson, P.N., Kim, S-K., Kim, B-H. and Yoon, Y-O., "Aluminum alloy with additions of magnesium, calcium and at least one of chromium, manganese and zirconium, and method of manufacturing the same", US Patent 11098391B2, Aug 24, 2021.
5. **Donald S Shih**, Yoshihito Kawamura, "Research activities at the Magnesium Research Center (MRC)", Impact, Vol 2020 Issue 2, 43-45, 2020.
6. Zhipeng Pan, Steven Y Liang, Hamid Garmestani, **Donald S. Shih**, Eric Hoar, "Residual stress prediction based on MTS model during machining of Ti-6Al-4V", Proceedings

of the Institution of Mechanical Engineers, Part C: Journal of Mechanical Engineering Science, Vol 233 Issue 11, 3743-3750, 2019.

7. Zhipeng Pan, **Donald S. Shih**, Hamid Garmestani, Steven Y Liang, "Residual stress prediction for turning of Ti-6Al-4V considering the microstructure evolution", Proceedings of the Institution of Mechanical Engineers, Part B: Journal of Engineering Manufacture, Vol 233 Issue 1, 109-117, 2019.
8. Pan, Z., Tabei, A., **Shih, D.S.**, Garmestani, H., and Liang, S.Y., "The effects of dynamic evolution of microstructure on machining forces", Proceedings of the institution of mechanical engineers, Part B: Journal of Engineering Manufacture, Vol 232 Issue 14, 2677-2681, 2018.
9. Smith, B.D., **Shih, D.S.,** and McDowell, D.M., "Cyclic Plasticity Experiments and Polycrystal Plasticity Modeling of Three Distinct Ti Alloy Microstructures," Intl J Plasticity, Vol 101, 11-23, Feb 2018.
10. Pan, Z., **Shih, D.S.,** Tabei, A., Garmestani, H., and Liang, S.Y., "Modeling of Ti-6Al-4V machining force considering materials microstructure evolution," The International Journal of Advanced Manufacturing Technology, Vol 91, 2673-2680, 2017.

11. Lee, S.W., Kim, K.M., Park, C.H., Hong, J.K., Yeom, J.K., and **Shih, D.S.**, "Effect of TiFe Intermetallic Compound on the Tensile Behavior of the Ti-4Al-4Fe-0.25Si Alloy," Metall Matls Trans A, Vol 48A, 561-567, Feb 2017.
12. Zhipeng Pan, **Donald S. Shih**, , Hamid Garmestani, Anthony D Rollett, Steven Y Liang, "MTS model based force prediction for machining of Ti-6Al-4V", Journal of Advanced Mechanical Design, Systems, and Manufacturing, Vol 11 Issue 3, JAMDSM0033, 2017.
13. Smith, B.D., **Shih, D.S.,** and McDowell, "Fatigue Hot Spot Simulation for Two Widmanstätten Ti Alloy Microstructures," Intl Journal of Fatigue, Vol. 92, 116-129, 2016.
14. Tabei, A., **Shih, D.S.**, Garmestani, H., and Liang, S.Y., "Micro-Texture Evolution in Aggressive Machining of Al Alloy 7075," Materials and Manufacturing Processes, 31 (13), 1709-1717, 2016.
15. Pan, Z., Liang, S.Y., Garmestani, H., and **Shih, D.S.**, "Prediction of machining-induced phase transformation and grain growth of Ti-6Al-4V alloy", The International Journal of Advanced Manufacturing Technology, Vol. 87, 859-866, 2016.
16. Tabei, A., **Shih, D.S.**, Garmestani, H., and Liang, S.Y., "Dynamic Recrystallization of Al Alloy 7075 in Turning," J Manufacturing Science Eng, 138 (7), 2016.
17. Tsuchiya, K., Emura, S., and **Shih, D.S.**, "Effect of Caliber Rolling on Microstructure and Mechanical Properties of Ti-6Al-4V," Proc of the 13th World Conference on Titanium (eds V Venkatesh et al), John Wiley & Sons, Inc., USA, May 2016.
18. Emura, S., Jiang, B., Tsuchiya, K., and **Shih, D.S.**, "Influence of Cold Caliber Rolling on Alpha Phase Formation in Metastable Beta Ti Alloys," Proc of the 13th World Conference on Titanium (eds V Venkatesh et al), John Wiley & Sons, Inc., USA, May 2016

19. Singh, A., Osawa, Y., Somekawa, H., Mukai, T., Parrish, C.J., and **Shih, D.S.**, "Effect of Alloy Composition on Microstructure and Strength of Fine Grained Extruded Mg-Zn-Y Alloys Containing Quasicrystal Phase," Magnesium Technology, The Materials Society, 215-220, 2015.
20. Tabei, A., **Shih, D.S.**, Garmestani, H., and Liang, S.Y., "Derivation of Process Path Functions in Machining of Al Alloy 7075," J Matls Eng & Performance, 24 (11), 4503-4509, 2015.

21. Lee, T., **Shih, D.S.**, and Lee, C.S., "Manufacturing Ultrafine-Grained Ti-6Al-4V Bulk Rod Using Multi-Pass Caliber-Rolling," Metals, 5 (2), 777-789, 2015.
22. Heo, T.W., **Shih, D.S.**, and Chen, L-Q., "Kinetic Pathways of Phase Transformation in Two-Phase Ti Alloys," Metall Matls Trans, 45A (8), 3232-3240, 2014.
23. Singh, A., Osawa, Y., Somekawa, H., Mukai, T., Parrish, C.J., and **Shih, D.S.**, "Development of Very High Strength and Ductile Dilute Magnesium Alloys by Dispersion of Quasicrystal Phase," Metall Matls Trans, 45A (8), 3438-3445, 2014.
24. **Shih, D.S.**, "Alloy by Design – R&D Effort on Ti and Mg Alloys at Boeing Research & Technology," Distinguished Keynote Address in *Aerospace Industry and New Materials in Next Generation*, Kumamoto, Japan, Apr 2013.
25. **Donald S. Shih**, "Research and Application of Mg Alloys for Aerospace", American Institute of Physics Keynote Speech Conference Proceedings, Orlando, FL, 2012.
26. Liu, M., **Shih, D.S.**, Parrish, C., and Atrens, A., "The Ignition Temperature of Mg Alloys WE-43, AZ31 and AZ91," Corrosion Science, Vol. 54, 2012, pp. 139-142.
27. **Donald S. Shih**, "A Case for ICME- Ti Alloy Design Tool Development at Boeing", TMS Keynote Speech, San Diego, CA, 2011.
28. **Shih, D.S.**, Britt, S.E., and McDowell, D.L., "Modeling the Deformation Response of Fully Lamellar α+β Titanium Alloys," Ti-2011, The 12th World Conference on Titanium, Beijing, China, June 2011.
29. **Shih, D.S.**, Trimarchi, G., Shih, D., Wolverton, C., and Freeman, A.J., "Designing Lighter Ti Alloys using First-principles Computational Approach," MMM 5th International Conference on Multiscale Materials Modeling, Freiburg, Germany, Oct 2010.
30. **Shih, D.S.**, Lawler, H., and Trinkle, D.R., "*Ab initio* Modeling to Improve Oxygen Tolerance of Ti Alloys," MMM 5th International Conference on Multiscale Materials Modeling, Freiburg, Germany, Oct 2010.

31. **Shih, D.S.** and Kim, Y.K., "Sheet Rolling and Performance Evaluation of Beta-Gamma (β–γ) Alloys", Proceedings of Ti-2007 Science and Technology, Kyoto, 1021, 2007.
32. **Shih, D.S.**, "High Performance Ultra-Lightweight Metals", DoD Report 1998.
33. Schwartz, D.S., **Shih, D.S.**, Lederich, R.L., Martin, R.L., and Deuser, D.A., "Development and Scale-up of the Low Density Core Process of Ti-64", in *Porous and Cellular Materials for Structural Applications*, *Schwartz, D.S., Shih, D.S., Evans, A.G., Wadley, H.N.G., Editors,* Matls Res Society proceedings, v.521, 225-230, 1998.

34. Schwartz, D.S., **Shih, D.S.,** Evans, A.G., Wadley, H.N.G., Editors, "Porous and Cellular Materials for Structural Applications," Matls Res Society, Vol 521, 1998.
35. Chan, K.S. and **Shih, D.S.**, "Fundamental Aspects of Fatigue and Fracture in a TiAl Sheet Alloy," Metall Matls Trans A, 29A (1), 73-87, 1998.
36. Chan, K.S. and **Shih, D.S.,** "Fatigue and Fracture of a Fine-Grained Lamellar TiAl Alloy," Metall Matls Trans A, 28A (1), 79-90, 1997.
37. J.C. Chestnut and **D.S. Shih**, "Wrought processing of a gamma titanium aluminide alloy Ti-48Al-2Cr-2Nb, Titanium'92: Science and technology, 1993.
38. **D.S. Shih**, D.S. Schwartz and J.E. O'Neal, "Effects of Strain Rate and Prestraining on Tensile Behavior of Duplex Gamma Titanium Aluminides". MRS Vol 288, 579-584, 1992.
39. Deve, H.E., Evans, A.G., and **Shih, D.S.,** "A High-Toughness γ-Titanium Aluminide," Acta Metall Mater 40 (6), 1259-1265, 1992.
40. Huang, S.C. Hall, E.L., and **Shih, D.S.,** "Microstructure and Ductility of TiAl Alloys Modified by Cr Addition", ISIJ international, 31 (10), 1100-1105, 1991.
41. Shyh-Chin Huang, **Donald S Shih**, "Gamma titanium aluminum alloys modified by chromium and tantalum and method of preparation", US Patent US5028491A, 1991.
42. **Donald S Shih**, Gary K Scarr, "High-Temperature Deformation Behavior of the γ Alloy Ti-48Ai-2Cr-2Nb", MRS Vol 727, 1991.
43. **D.S. Shih**, S.C. Huang, G.K. Scarr, H. Jang, J.C. Chesnutt, "Microstructure/Property Relationships in Titanium Aluminides and Alloys", TMS, 135-148, 1991.
44. Huang, S.C. and **Shih, D.S.,** "Microstructure/Property Relationships in Titanium Aluminides and Alloys", TMS, 105, 1990.
45. **Shih, D.S.,** Amato, R.A., "Interface Reaction between Gamma-TiAl Alloys and Reinforcements," Scripta Metall Mater, 24 (11), 2053-2058, 1990.
46. **Shih, D.S.** and Scarr, G.K., and Wasielewski, "On Hydrogen Behavior in Ti_3Al", Scripta Metall, 23 (6), 973-978, 1989.
47. **Donald S Shih**, Gary K Scarr, James C Chesnutt"On Microstructural Evolution in Gas Atomized Ti-50 at.% Al-2 at.% Nb Powder", MRS, Vol 133, 1988.
48. Robertson, I.M., Bond, G.M., Lee, T.C., **Shih, D.S.**, and Birnbaum, H.K., "Dynamic Studies of Deformation and Fracture at Grain Boundaries," Le Journal de Physique Colloques, 49 (C5), Oct 1988.
49. **Shih, D.S.** and Birnbaum, H.K., "Evidence of FCC Titanium Hydride Formation in β Titanium Alloy: an X-ray Diffraction Study," Scripta Metall, 20 (9), 1261-1264, 1986.
50. **Shih, D.S., Robertson, I.M., and Birnbaum, H.K., "Hydrogen Embrittlement of α Titanium: *in situ* TEM Studies," Acta Metall, 36 (1), 111-124, 1988.**

Synergistic Activities

Dr. Don Shih is a world leading researcher in ICME and Materials Genome Initiative (MGI) related effort in the world, including digital databases and data mining at Boeing Research & Technology (BR&T). He also served on several committees (Ti, light metals, and EMPD) and the IMMI journal at TMS. He was a key technical fellow focal point for BR&T's global metal technology strategy and oversight. In August 2013, he, as the industry principle investigator, with Professor Dave McDowell and Professor Surya Kalidindi of Georgia Tech won a US NSF (National Science Foundation) award, http://www.nsf.gov/awardsearch/showAward?AWD_ID=1333083 ($720,000 for 3 years) on modeling and prediction of fatigue life in metallics with microstructural sensitivity using crystal plasticity theory and 2-point correlation methodology.

Dr. Shih had been a co-adviser for many MS and PhD students at Georgia Tech and Kumamoto University. He was the focal point in establishing the MoU relationship for Kumamoto University with the National Cheng Kung University and the National Taiwan University.

Note: Dr Donald S. Shih is a citizen of both the U.S. and Taiwan.