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Professional Profile

Dr. Hayes has extensive experience solving complex technical problems in a variety of industries including consumer electronics, consumer products, medical devices, vehicles, industrial equipment, and technology product development. He has conducted technology due diligence reviews of emerging technologies and intellectual property (IP) for clients such as investment firms, IP owners, and companies interested in purchasing IP or the associated products.

Dr. Hayes routinely performs failure analysis investigations on a variety of consumer electronics as well as commercial and industrial products. He specializes in the mechanical behavior, degradation and failure of materials including metal, polymer, ceramic and glasses. He has expertise in the areas of materials characterization, fatigue, fracture, and creep. He often works with companies addressing the technical aspects of consumer product recalls.

Dr. Hayes works extensively on projects involving battery design, manufacturing, and failure analysis. In addition to performing root cause analyses of products involving battery failures, he has conducted more than 80 on-site technical manufacturing line evaluations of battery cell and battery pack manufacturers. He assists clients by conducting design reviews of batteries and battery packs to evaluate the potential for safety issues or field failures. Dr. Hayes also helps many clients evaluate and choose vendors that have the capability to produce batteries with the quality and safety the client requires.

In addition to battery factory evaluations, Dr. Hayes conducts technical manufacturing line evaluations for processes such as consumer electronics assembly, printed circuit board assembly (PCBA), chemical etching, injection molding, and metal casting and forming. The focus of such site assessments is to improve the quality, reliability, and safety of the products and minimize reject rates through a detailed evaluation of the equipment, processes, and quality control in the factory.

Academic Credentials & Professional Honors

Ph.D., Materials Science and Engineering, University of California, San Diego, 2004

M.S., Materials Science and Engineering, Oregon State University, 1996

B.S., Mechanical Engineering, Oregon State University, 1995

Licenses and Certifications

Professional Engineer Metallurgical, California, #1938 Certified ISO 9001:2000 Lead Auditor

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Prior Experience

Senior Scientist, Institute of Risk & Safety Analyses, 2001-2005

Professional Affiliations

Materials Research Society

The Minerals, Metals and Materials Society

ASM International

Languages

Mandarin Chinese

Publications

A. Cohn, T. Hayes, J. Harding and Q. Horn, “The Low-Voltage Limits of Lithium-Ion Batteries: Overdischarge and Degradation from a Safety Perspective,” ISTFA™ 2022: Conference Proceedings from the 48th International Symposium for Testing and Failure Analysis October 30–November 3, 2022, Pasadena Convention Center, Pasadena, California, USA, pp 47 – 50.

T. Hayes, A. Cohn, R. Kasse and H. Sanchez, “Advanced Lithium-Ion Battery Failure Analysis: An Evolving Methodology for an Evolving Technology,” ISTFA™ 2022: Conference Proceedings from the 48th International Symposium for Testing and Failure Analysis October 30–November 3, 2022, Pasadena Convention Center, Pasadena, California, USA, pp 51 – 57.

Hayes TA, Piper J, Glazer M, Cylindrical Li-Ion Battery Cells and Their Use with E-Cigarettes, Defense News: The Legal Journal for New Mexico Civil Defense Lawyers, DLA, Winter 2018/2019.

Hayes TA, Wei W. The effects of mechanical shock on batteries enclosed in mobile devices, Proceedings of the IEEE Symposium on Product Compliance Engineering, San Jose, CA, May 14-16, 2018.

Hayes, TA, Kassner ME. Creep of zirconium and zirconium alloys. I. Charit et al. (eds.), Mechanical and Creep Behavior of Advanced Materials, The Minerals, Metals & Materials Series, 2017, 103 - 114.

Kassner ME, Perez Prado MT, Hayes TA, Jiang L, Barrabes SR, Lee IF. Elevated temperature deformation of Zr to large strains. Journal of Materials Science 2013; 48-13: 4492-4500.

Hayes T, Mikolajczak C, Megerle M, Wu M, Gupta S, Halleck P. Use of CT scanning for defect detection in lithium-ion batteries. Battery Power, March/April 2011, V15-2:14-17.

Hayes TA, Mikolajczak C, Horn Q. Key manufacturing practices to achieve high quality cells. Proceedings, 27th International Battery Seminar & Exhibit for Primary & Secondary Batteries, Small Fuel Cells, and Other Technologies, Ft. Lauderdale, FL, March 15-18, 2010.

Mikolajczak C, Harmon J, Gopalakrishnan P, Godithi R, Hayes T, Wu M. From lithium plating to cell thermal runaway: A combustion perspective. Proceedings, 27th International Battery Seminar & Exhibit for Primary & Secondary Batteries, Small Fuel Cells, and Other Technologies, Fort Lauderdale, FL, March 15-18, 2010.

Hayes T, Mikolajczak C, Megerle M, Wu M, Gupta S, Halleck P. Use of CT scanning for defect detection in lithium-ion batteries. Proceedings, 26th International Battery Seminar & Exhibit for Primary & Secondary Batteries, Small Fuel Cells, and Other Technologies, Fort Lauderdale, FL, March 16-19, 2009.

Mikolajczak C, Harmon J, Hayes T, Megerle M, White K, Horn Q, Wu M. Li-ion battery cell failure analysis: The significance of surviving features on copper current collectors in cells that have experienced thermal runaway. Proceedings, 25th International Battery Seminar & Exhibit for Primary & Secondary Batteries, Small Fuel Cells, and Other Technologies, Fort Lauderdale, FL, March 17-20, 2008.

Mikolajczak CJ, Hayes TA, Megerle MV, Wu M. A scientific methodology for investigation of a lithium ion battery failure. IEEE Portable 2007 International Conference on Portable Information Devices, IEEE No. 1-4244-1039-8/07, Orlando, FL, March 2007.

Mergele MV, Hayes TA, Horn W. Methodologies of identifying root causes of failures in lithium ion battery packs. Proceedings, 24th International Battery Seminar & Exhibit for Primary & Secondary Batteries, Small Fuel Cells, and Other Technologies, Ft. Lauderdale, FL, March 19, 2007.

Hayes TA, Rosen RS, Kassner ME. Creep fracture of zirconium alloys. J Nuc Mater 2006; 353:109-118.

Hayes TA, Kassner ME. Creep of zirconium and zirconium alloys. Metall and Mater Trans 2006; 37A:2389-2396.

Hayes TA, Kassner ME. Creep of zirconium and zirconium alloys. Proceedings, Symposium Sponsored by Materials Science and Technology, Creep Deformation and Fracture, Design, and Life Extension, pp. 13-25, Pittsburgh, PA, September 25-28, 2005.

Hayes TA, Rosen RS, Kassner ME. Creep fracture of zirconium alloys. Proceedings, Symposium Sponsored by Materials Science and Technology, Creep Deformation and Fracture, Design, and Life Extension, pp. 27-39, Pittsburgh, PA, September 25-28, 2005.

Hayes TA. Creep and creep fracture of zirconium and zirconium alloys. Ph.D. Dissertation, University of California, San Diego, 2004, 391 pp.

Kassner ME, Hayes TA. Creep cavitation in metals. Int J Plasticity 2003; 19:1715-1748.

Barrabes S, Daraio C, Kassner ME, Hayes TA, Wang MZ. Dynamic restoration mechanisms and discontinuous dynamic recrystallization in α-Zirconium. pp. 825-839. In: Light Metals. Lewis T (ed), Canadian Inst. of Mining, Metallurgy and Petrol. Engineers, Montreal, 2002.

Hayes TA, Kassner ME, Rosen RS. Steady state creep of α-Zirconium at temperatures up to 850°C. Metall Mater Trans 2002: 33A:337-343.

Hayes TA, Rosen RS, Kassner ME, Vecchio KS. Analysis of dry storage temperature limits for zircaloy-clad spent nuclear fuel based on diffusion-controlled cavity growth. Proceedings, Scientific Basis for Nuclear Waste Management XXIII, Boston, MA, Materials Research Society, Vol. 608, pp. 23-28, 2000.

Kassner ME, Hayes TA. Subgrain strengthening revisited II. Proceedings, Deformation Processing and Properties of Structural Materials, Honorary Symposium for Professor Oleg D. Sherby (invited paper), TMS, Warrendale, PA, pp. 121-130, 2000.

Hayes TA, Rosen RS. Steady state creep of zirconium at high and intermediate temperatures. Proceedings, 8th Int'l Symposium on Plasticity and its Current Applications, Plastic and Viscoplastic Response of Materials and Metal Forming, Neat Press, 2000, pp. 342-344, Whistler, Canada, July 16-20, 1999.

Rosen RS, Hayes TA. Modeling creep rupture of zirconium alloys. Proceedings, 8th Int'l Symposium on Plasticity and its Current Applications, Plastic and Viscoplastic Response of Materials and Metal Forming, Neat Press, 2000, pp. 369-371, Whistler, Canada, July 16-20, 1999.

Hayes TA, Rosen RS, Kassner ME. Critical analysis of interim dry storage temperature limits for zircaloy-clad spent nuclear fuel based on diffusion-controlled cavity growth. Lawrence Livermore National Laboratory, Report UCRL-ID-131098, 145 pp, December 1999.

Hayes TA, Kassner ME. Elastic constants, hardness and wear, intrinsic stress and thermal expansion coefficients in a-Si and Si:H. pp. 356-372. In: Properties of Amorphous Silicon and Its Alloys. T.M. Searle (ed), Inst. Electrical Engineers INSPE, Stoneridge, Herts, UK, 1998.

Hayes TA, Kassner ME, Rosen RS, Amick DA. Thermal stability of surface deformed zirconium. J Nuc Mater 1997; 246:60-69.

Hayes TA. Thermal stability of surface treated zirconium. Masters Thesis, Oregon State University, 137 pp, 1996.

Bergsm SC, Kassner ME, Li X, Delos-Reyes MA, Hayes TA. The optimized properties of the new aluminum alloy 6069. J Eng Mater Perf 1996; 5:111-116.

Book Chapters

Horn Q, Hayes T, Slee D, White K, Harmon J, Godithi R, Wu M, Megerle M, Singh S, Mikolajczak C. Methodologies for battery failure analysis. In: Handbook of Batteries, Fourth Edition. Thomas Reddy (ed), McGraw-Hill, October 2010.

Hayes TA, Kassner ME. Elastic constants, hardness and wear, intrinsic stress and thermal expansion coefficients in a-Si and Si:H. pp. 356-372. In: Properties of Amorphous Silicon and its Alloys. Searle TM (ed), Inst. Electrical Engineers INSPE, Stoneridge, Herts, UK.

Selected Presentations

Hayes, TA, Spray, RL, Wright, SA, Barry, M. Culprits or Collateral Damage? Lithium-Ion Batteries in Fire Investigations, Exponent Live Webinar, October 21, 2021.

Hayes, TA, Cohn, AP, Sanchez, H. Advanced Failure Analysis for Lithium-Ion Batteries, Exponent Live Webinar, May 13, 2021.

Hayes, TA, Lai, R, Ye, R. How Do You Choose A Battery Manufacturer For Your Device? Part 2: Cell and Pack Manufacturing Audits, Exponent Live Webinar, March 16, 2021.

Hayes TA, Piper J. Catastrophic Thermal Battery Failures in Vaping Devices and in Pockets: Why do They Happen?, International Association of Defense Counsel (IADC) Webinar, March 13, 2019.

Hayes TA, Wei W. The effects of mechanical shock on batteries enclosed in mobile devices. ISPCE 2018, IEEE Symposium on Product Compliance Engineering, San Jose, CA, May 16, 2018.

Hayes TA, Wei W. The Effects of Mechanical Shock on Batteries Enclosed in Mobile Devices as part of the Internet of Things (IoT) Thermal Management panel session, The Intersociety Conference on Thermal and Thermomechanical Phenomena in Electronic Systems, ITHERM 2017, Orlando Florida, June 2, 2017.

Hayes TA. Creep of zirconium and zirconium alloys, TMS 2017, San Diego, California, March 2017 (Invited Talk).

Hayes TA. Considerations when choosing batteries made in China. The 4th EV Li-Ion Battery Forum 2011, Shanghai, China, November 2011.

Hayes TA. Considerations when choosing batteries made in China. Lithium Asia 2011, Shanghai China, September 2011.

Hayes TA. Considerations when choosing batteries made in China. The 3rd EV Li-Ion Battery Forum 2011, Barcelona, Spain, April 2011.

Hayes TA. 1-day training course: Detecting failures and manufacturing defects in Li-ion batteries. The 3rd EV Li-Ion Battery Forum 2011, Barcelona, Spain, April 2011.

Hayes TA. 2-day training course: Manufacturing, testing and recycling safe EV Li-Ion batteries. The 2nd EV Li-Ion Battery Forum 2010, Beijing China, August 2010.

Hayes TA. Analyzing electronic product battery failures. GlobalSpec Webinar on Electronic Product Design, June 2010.

Hayes TA, Mikolajczak C, Horn Q. Key Manufacturing Practices to Achieve High Quality Cells, 27th International Battery Seminar & Exhibit, Ft. Lauderdale, FL, March 16, 2010.

Hayes TA. Identifying a non-safe Li-ion battery in the production cycle to avoid safety recalls and maintaining your brand's trust. EV Li-ion Forum 2009, Shanghai China, September 2-3, 2009.

Hayes TA. 1-day workshop: Design and manufacturing of safe lithium ion batteries for EVs. The EV Li-Ion Battery Forum 2009, Shanghai China, September 2009.

Hayes TA, Mikolajzak CJ, Megerle MV, Wu M, Gupta S, Halleck P. Use of CT scanning for defect detection in lithium ion batteries. The 7th China International Battery Power Supply System of Advanced Technology and Market Seminar, Shanghai China, July 2009 (in Mandarin Chinese).

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Mergele MV, Hayes TA, Horn W. Methodologies of identifying root causes of failures in lithium ion battery packs. 24th International Battery Seminar & Exhibit, Ft. Lauderdale, FL, March 19, 2007.

Hayes TA, Du Y. A scientific methodology for investigation of a lithium ion product failure. 4th International Battery Exhibition, Shanghai, China, November 9, 2005.

Hayes TA. Creep of zirconium and zirconium alloys. Creep Deformation and Fracture, Design, and Life Extension, Materials Science & Technology (MS&T'05), Pittsburgh, PA, September 25-28, 2005 (Invited Talk).

Hayes TA. Creep fracture of zirconium alloys. Creep Deformation and Fracture, Design, and Life Extension, Materials Science & Technology (MS&T'05), Pittsburgh, PA, September 25-28, 2005 (Invited Talk).

Hayes TA. Analysis of dry storage temperature limits for Zircaloy-clad spent nuclear fuel based on diffusion-controlled cavity growth. Scientific Basis for Nuclear Waste Management XXIII, Materials Research Society, Boston, MA, 2000.

Hayes TA. Steady state creep of zirconium at high and intermediate temperatures. Plastic and Viscoelastic Response of Materials and Metal Forming, Whistler, Canada, July 16-20, 1999.

Hayes TA. Modeling creep rupture of Zirconium alloys. Plastic and Viscoelastic Response of Materials and Metal Forming, Whistler, Canada, July 16-20, 1999.

Trial or Arbitrations (5 years)

Kent Howard v. Liberty Hardware Mfg. Corporation, in the Circuit Court of the Seventeenth Judicial Circuit in and for Broward County, Florid, Case No. CACE21-21982 (DIV 12), April 2023.

Deposition & Trial Testimony (5 years)

Maxell, Ltd., v ***Amperex Technology Limited****, United States District Court for the Western District of Texas, Waco Division, Case No. 6:21-cv-347-ADA, March 2023.*

Jonathan Freed v. ***Samsung SDI Co. Ltd.****, Superior Court of California, County of San Francisco, Case No. CGC-17-560656, June 2022.*

Scott Schroeck and Denise Schroeck v. Izhak Convenient Company d/b/a Tobacco & Cigars, et al. ***(LG Chem, Ltd.)****,* Circuit Court of Cook County, Illinois, Cause No. 2017L006427, December 2020.

Scott Hildreth and Jessica Hildreth v. Naples Vapor, LLC et al. ***(Samsung SDI)****,* Circuit Court of the Twentieth Judicial District in and for Collier County, Florida, Case No. 18-CA-373, July 2020.

Certain Lithium Ion Batteries, Battery Cells, Battery Modules, Battery Packs, Components Thereof, and Processes Therefor ***(LG Chem, Ltd.)***, United States International Trade Commission, Washington D.C., Inv. No. 337-TA-1159, January 2020.

Vigilant Insurance Company v. ***Techtronic Industries Co., Ltd***, United States District Court, Western District of Washington at Tacoma, Case No. 3:18-cv-05376-BHS, August 2019.

Kruep v. Smoke Smart LLC ***(LG Chem, Ltd.)***, Missouri District Court, Twenty-Second Judicial District, City of Saint Louis, Case No. 1622-CC11455, May 2019.

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