Christopher James Janke
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Areas of Research:

Polymer Matrix Composites; Thermoset and Thermoplastic Resins; Elastomers; Carbon Materials; Process Science & Engineering; Physical, Mechanical, Chemical and Thermal Characterization and Testing of Materials; Composite Structures; Nondestructive Evaluation & Testing; Resin Formulation; Composite Manufacturing; Fiber Converting; Prepregging; Tooling; Radiation Processing of Composites and Adhesives; Radiation Grafting; Polymeric Adsorbent Development and Testing; Lithium-Ion Batteries; Project Management.

Bio:

Mr. Janke received a B.S. in chemistry from Appalachian State University, Boone, North Carolina, in 1983 and an M.S. in chemistry from the University of Tennessee, Knoxville, in 1986. He was employed by Milliken and Company from 1986-88 as a Development Engineer responsible for the development and formulation of new adhesive systems and reinforcement fabrics. Since 1988 he has been employed at the Oak Ridge National Laboratory as a Senior R&D Staff Member involved in radiation processing and grafting, polymer matrix composites and process engineering. Chris has published extensively in numerous technical areas and has formally presented his work at many national and international conferences and workshops. He has over 60 publications, three R&D 100 Awards, six patents, several pending patents and commercial licenses. He has also hosted four workshops on electron beam curing of composites, chaired several conference sessions on composites and is recognized in "Who's Who in Polymers and Plastics".

Since 2010 Chris has served as technical lead on the development, synthesis and testing of fiber-based adsorbents for extracting uranium from seawater that have high capacity, selectivity, durability and rapid loading and elution kinetics. In this project Chris has managed subcontracts with several fiber, textile and irradiation companies; and conducted extensive collaborations with many organizations including ORNL, PNNL, LBNL, LANL, BNL, Woods Hole Oceanographic Institute, numerous universities and with scientists and engineers from China and Japan including the Chinese Academy of Sciences, Shanghai's Institute of Applied Physics and Japan's Atomic Energy Research Institute. In 2012 he received an **R&D 100 Award** for the development of HiCap Adsorbents which demonstrated the world's highest uranium adsorption capacity from seawater. In 2015 he also initiated a new project on developing electron beam curable binder materials for reducing the cost of manufacturing lithium-ion batteries.

During 2007-2016 Chris has conducted materials compatibility studies of many ethanol, isobutanol and bio-oil containing fuels with a wide range of plastic, elastomer and composite materials. In this project he conducted rate dependant degradation of mechanical, thermal and physical properties and worked closely with the Underwriters Laboratories (UL), NREL and Butamax to provide technical information on materials issues related to fuel dispensers, underground piping, storage tanks and fuel handling systems that operate under dynamic conditions.

During the 1990's and 2000's Chris served as principal investigator, project manager, and task leader on over 25 different projects on electron beam curing of polymer matrix composites and adhesives including one of the largest multi-organizational CRADA's ever signed, a 3-year, 7-million dollar DOE-sponsored partnership entitled, "Electron Beam Curing of Polymer Matrix Composites", involving 10 industrial companies and three DOE laboratories. For over 15 years Chris developed, formulated, and characterized hundreds of electron beam curable cationic epoxy resins systems for various composite and adhesive applications. In this work he also conducted research in the areas of processing development, low-cost tooling development, prototype manufacture, curing kinetics, fiber/matrix interface optimization, and economic studies. He also served as principal investigator on a 3-year, 3.2-million dollar DOE-sponsored CRADA entitled, "Interfacial Properties of Electron Beam Cured Composites", involving 11 industrial companies, US Air Force, US Army, and NASA. In 1997 he received an **R&D 100 Award** for "Electron-Beam-Curable Cationic Epoxy Resins", a 1997 Lockheed Martin Technical Achievement Award for "Creating Major Breakthroughs in Composites Materials Processing Using Electron Beam Energy for Curing" and a 1998 AMSE Technological Achievement Award for "Electron-Beam Curable Cationic Epoxy Resins".

For over 20 years Chris served as project manager on many Navy and Air Force projects concerned with the residual mechanical, physical, thermal, and chemical properties characterization of heat damaged composites. These projects resulted in the successful development of the only known nondestructive inspection spectroscopic techniques that possess the unique capability of detecting and quantifying heat damage in composites. In 2008, R&D efforts culminated in the successful development, demonstration, and transition of the first-of-its-kind, commercially available, nondestructive Laser-Induced Fluorescence (LIF) Composite Heat Damage Detector that provides highly accurate and rapid heat damage assessments of fiber-reinforced composites. The LIF instrument is user-friendly, lightweight, portable, and highly reliable and is currently being used at various Navy Repair Depots in support of several aircraft platforms. In 2008 he received an **R&D 100 Award** for the "Laser-Induced Fluorescence Composite Heat Damage Detector".

Chris has also worked in several other projects including:

1. Long-lived polymer electrolytes for lithium-ion batteries;
2. Super hard surfaced polymers produced via high energy, heavy-ion beam irradiation;
3. Interfacial optimization of carbon fiber composites containing polyesters, vinyl esters and thermoplastic resin systems;
4. Non-contact, non-destructive cure state measurement of adhesives, sealants and coatings using Laser-Induced Fluorescence spectroscopy;

5. High performance centrifuges for uranium enrichment;
6. Composite parts for the U.S. Navy's Seawolf Submarine;
7. High temperature superconductivity;
8. Development of low-cost carbon fibers including radiation stabilization of polyacrylonitrile fibers;
9. Laser cutting of carbon fibers;
10. Fusion bonded epoxy coatings for gas and liquid pipelines;
11. New and faster method for manufacturing carbon-carbon composites;
12. Carbon nanomaterials;
13. Rapid composite preform manufacturing methods including the programmable, powdered perform process (P4) and slurry process;
14. Resin preform permeability;
15. Insulation materials for Compact Ignition Tokamak Fusion Machine;
16. Fabrication of composite overwrapped metal tubes;
17. Durability studies of fiber-reinforced thermoplastic composites for automotive applications including carbon/polyphenylene sulfide (PPS) composites;
18. Advanced power transmission composite conductors;
19. Lightweight, low-noise composite housings for U.S. Army power generators;
20. U.S. Army's Fiber Optic Guided Missile program;
21. Elastomeric o-ring investigations in support of the Spallation Neutron Source (SNS) facility;
22. Radiation shielding materials for outer space applications;
23. Hydrogen storage materials;
24. Composite materials investigation in support of Oak Ridge's Toxic Substance Control Act (TSCA) Incinerator;
25. Safety analysis reports in support of the Atomic Vapor Laser Isotope Separation (AVLIS) Program.

Chris has experience in a wide range of composite processing methods, NDE techniques and analytical methods including: oven, autoclave, electron beam, X-ray and gamma radiation processing; adhesive bonding, hand lay-up, filament winding, fiber/tape placement, RTM, VARTM, pultrusion, compression molding, honeycomb/sandwich composites, rotational molding, RIM, injection molding, and textile processing (braiding, weaving, knitting); ultrasonics, leaky-lamb waves, DMA, DSC, TGA, laser-induced fluorescence, FTIR, ATR, DRIFT and UV-Vis spectroscopy, NMR, rheometry, ICP, SEM/EDX, EPR and elemental analysis. He has also had extensive interactions and collaborations with a variety of: DOE, DoD and industrial sponsors; aerospace, automotive and marine companies; resin, fiber, prepreg and tooling manufacturers; and university researchers and international collaborators including Chinese, Japanese and Canadian scientists and engineers.

Awards:

1. **2012 R&D 100 Award** – HiCap Adsorbents – Janke, C.J.; Tsouris, C.; Sun, X.G.; Mayes, R.T.; Oyola, Y.; Dai, S.; Bauer, C.; Saito, T.; Brang, J.; Haggard, J.; ORNL and Hills, Inc.
2. **2008 R&D 100 Award** – Laser-Induced Fluorescence (LIF) Composite Heat Damage Detector – Janke, C.J.; Fisher, J.; Fisher, W.; Wachter, E.; Clemons, A.; Eberle, C.; Maxey, C.; Storey, J.; ORNL and Galt Technology LLC.
3. **1998 AMSE Technological Achievement Award** - Electron-Beam Curable Cationic Epoxy Resins.
4. **1997 R&D 100 Award** - Electron-Beam-Curable Cationic Epoxy Resins – Janke, C.J.; Dorsey, G.F.; Havens, S.J.; Lopata, V.J.; ORNL, Y-12 and Atomic Energy of Canada Limited (AECL).
5. **1997 Lockheed Martin Technical Achievement Award** - Creating Major Breakthroughs in Composites Materials Processing Using Electron Beam Energy for Curing.

Patents:

1. Janke, C.J.; Dai, S.; Oyola, Y.; Powder-Based Adsorbents Having High Adsorption Capacities for Recovering Dissolved Metals and Methods Thereof. Application No. 14/697,711; April 28, 2015; UT-B Ref. 2635.4; WNJ Ref. 138974.163514-US.
2. Janke, C.J.; Dai, S.; Oyola, Y.; Foam-Based Adsorbents Having High Adsorption Capacities for Recovering Dissolved Metals and Methods Thereof. U.S. Patent No. 9,044, 739 B2; June 2, 2015.
3. Janke, C.J.; Dai, S.; Oyola, Y.; Fiber-Based Adsorbents Having High Adsorption Capacities for Recovering Dissolved Metals and Methods Thereof. U.S. Patent No. 8,722,757 B2; May 13, 2014.
4. Naskar, A.K.; Paulauskas, F.L.; Warren, C.D.; Janke, C.J.; Sulfonated Polyolefin-Based Flame Retardent Material. U.S. Patent Application 14/175,218 filed Feb. 7, 2014.
5. Huff, S.P.; Janke, C.J.; Kass, M.D.; Lewis, S.A.; Pawel, S.J.; Theiss, T.J.; System for Determining Biofuel Concentration. U.S. Patent Application 13/939,479 filed July 11, 2013.
6. Howell, D.; Janke, C.J.; Eberle, C.C.; Ionizing Radiation Post-Curing of Objects Produced by Stereolithography and Other Methods. U.S. Patent No. 6,107,008; August 22, 2000.
7. Janke, C.J.; Lopata, V.J.; Havens, S.J.; Dorsey, G.F.; Moulton, R.J.; High Energy Electron Beam Curing Of Epoxy Resin Systems Incorporating Cationic Photoinitiators. U.S. Patent No. 5,877,229; March 2, 1999.
8. Janke, C.J.; Dorsey, G.F.; Havens, S.J.; Lopata, V.J.; Toughened Epoxy Resin System and a Method Thereof. U.S. Patent No. 5,726,216; March 10, 1998.
9. Janke, C.J.; Dorsey, G.F.; Havens, S.J.; Lopata, V.J.; Moulton, R.J.; Ionizing Radiation Curing Of Epoxy Resin Systems Incorporating Cationic Photoinitiators. EP 0 843 685 B1, Date of Publication: 24.09.2003, Application no.: 96925514.0, Date of filing: 26.07.1996, Intl. Application no. PCT/US96/12302, Intl. Publication no. WO 97/005172 (13.02.1997 Gazette 1997/08).

Recent News

http://www.nature.com/news/seven-chemical-separations-to-change-the-world-1.19799

Journal Publications:

1. Du, Z., Janke, C.J., Li, L., Daniel, C., Wood, D.L., Electron beam curing of composite positive electrode for Li-ion battery; J. Electrochem. Soc.; *Pending journal article.*

2. Kass, M.D., Janke, C.J., Connatser, R.M., Lewis, S.A., Keiser, J.R., Gaston, K.; Compatibility Assessment of Fuel System Elastomers to Bio-oil and Diesel Fuel; Energy & Fuels; *Pending journal article.*

3. Das, S., Janke, C.J., Brown, S., Mayes, R.T., Gill, G., Dai, S.; Advanced Functional Polymer Sorbent for Uranium Recovery from Seawater; *Pending journal article.*

4. Das, S.; Brown, S; Mayes, R.T.; Janke, C.J.; Tsouris, C.; Kuo, L.J.; Gill, G.; Dai, S.; Novel Poly(imide dioxime) sorbents: Development and Testing for Enhanced Extraction of Uranium from Natural Seawater; Chemical Engineering Journal; **2016**, 298, 125-135; DOI information: 10.1016/j.cej.2016.04.013.

5. Keiser, J.R., Brady, M.P., Lewis, S.A., Connatser, R.M., Kass, M.D., Leonard, D.N., Janke, C.J., Materials Issues In Thermochemical Production, Processing and Utilization Of Bio-Oil. *Corrosion 2016 Conference and Expo*, Vancouver, Canada, March 6-10, 2016.

6. Oyola, Y.; Jankc, C.J.; Dai, S.; Synthesis, development and testing of high surface area polymer-based adsorbents for the selective recovery of uranium from seawater. Industrial and Engineering Chemistry Research, February 29, 2016; 10.1021/acs.iecr.5b03981.

7. Brown, S.; Chatterjee, S.; Yue, Y.; Tsouris, C.; Janke, C.; Saito, T.; Dai, S.; Uranium adsorbent fibers prepared by ATRP from chlorinated PP and PE trunk fibers. Industrial and Engineering Chemistry Research, December 2015; doi:10.1021/acs.iecr.5b03667.

8. Gill, G.A.; Kuo, L.J.; Janke, C.J.; Park, J.; Jeters, R.; Bonheyo, G.; Pan, H.B.; Wai, C.; Khangaonkar, T.; Bianucci, L.; Wood, J.; Warner, M.G.; Peterson, S.; Abrecht, D.; Mayes, R.T.; Tsouris, C.; Oyola, Y.; Strivens, J.E.; Schlafer, N.; Addleman, R.S.; Chouyyok, W.; Das, S.; Kim, J.; Buesseler, K.; Breier, C.; D'Alessandro, E.; The uranium from seawater program at PNNL: Marine testing, adsorbent characterization, adsorbent durability, adsorbent toxicity, and deployment studies. Industrial and Engineering Chemistry Research; February 2016; doi: 10.1021/acs.iecr.5b03649.

9. Park, J.; Gill, G.; Strivens, J.; Kuo, L.J.; Jeters, R.; Avila, A.; Wood, J.; Schlafer, N.; Janke, C.; Miller, E.; Thomas, M.; Addleman, R.S.; Bonheyo, G.T.; Effect of biofouling on the performance of amidoxime-based polymeric uranium adsorbents. Industrial and Engineering Chemistry Research; January 2016; doi: 10.1021/acs.iecr.5b03457.

10. Ladshaw, A.P.; Das, S.; Liao, W.P.; Yiacoumi, S.; Janke, C.J.; Mayes, R.T.; Dai, S.; Tsouris, C.; Experiments and modeling of uranium adsorption in the presence of other ions in simulated seawater. Industrial and Engineering Chemistry Research, November 2015; doi: 10.1021/acs.iecr.5b03456.

11. Pan, H.B.; Kuo, Miyamoto, N.; Wood, J.R.; Strivens, J.E.; Gill, G.A.; Janke, C.J.; Wai, C.M.; Elution of uranium and transition metals from amidoxime-based polymer adsorbents for sequestering uranium from seawater. Industrial and Engineering Chemistry Research, November 2015; doi: 10.1021/acs.iecr.5b03307.

12. Kuo, L.J.; Janke, C.J.; Wood, J.R.; Strivens, J.E.; Gill, G.A; Characterization and testing of amidoxime-based adsorbent materials to extract uranium from natural seawater. Industrial and Engineering Chemistry Research, November 2015; doi: 10.1021/acs.iecr.5b03267.

13. Das, S.; Liao, W.P.; Flicker Byers, M.; Tsouris, C.; Janke, C.J.; Mayes, R.T.; Schneider, E.; Kuo, L.J.; Gill, G.; Dai, S.; Alternative alkaline conditioning of amidoxime based adsorbent for uranium extraction from seawater. Industrial and Engineering Chemistry Research, October 2015; doi: 10.1021/acs.iecr.5b03210.

14. Das, S.; Mayes, R.T.; Janke, C.J.; Kuo, L.J.; Gill, G.; Wood, J.; Dai, S.; Extracting Uranium from Seawater: Promising AF Series Adsorbents. Industrial and Engineering Chemistry Research, November 2015; doi: 10.1021/acs.iecr.5b03136.

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18. Das, S.; Tsouris, C.; Zhang, C.; Brown, S.; Janke, C.J.; Mayes, R.T.; Kuo, L.J.; Gill, G.; Dai, S.; Enhancing Uranium Uptake by Amidoxime Adsorbent in Seawater: An investigation for optimum alkaline conditioning parameters. Journal of Industrial and Engineering Chemistry Research, September 2015; doi:10.1021/acs.iecr.5b02735.

19. Kass, M., Janke, C., Connatser, R., Lewis, S. et al., "Compatibility Assessment of Elastomeric Infrastructure Materials with Neat Diesel and a Diesel Blend Containing 20 Percent Fast Pyrolysis Bio-oil," SAE Int. J. Fuels Lubr. 8(1):2015, doi:10.4271/2015-01-0888.

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21. Kass, M., Janke, C., Theiss, T., Baustian, J. et al., "Compatibility Assessment of Plastic Infrastructure Materials with Test Fuels Representing E10 and iBu16," SAE Int. J. Fuels Lubr. 8(1):2015, doi:10.4271/2015-01-0894.

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23. Pan, H.B; Liao, W.; Wai, C.M.; Oyola, Y.; Janke, C.J.; Tian, G.; Rao, L.; Carbonate-H_2O_2 Leaching for Sequestering Uranium from Seawater. *Dalton Transactions*, **2014**, 43, 10713-10718.

24. Britt, P.F., Dai, S., Hay, B., Janke, C.J., Mayes, R.T., Saito, T., Tsouris, C., Rao, L.; Development of Polymeric Adsorbents for Recovery of Uranium from Seawater. *The International Symposium on Uranium Raw Material for the Nuclear Fuel Cycle: Exploration, Mining, Production, Supply and Demand, Economics and Environmental Issues (URAM 2014).* Vienna, Austria, June 23-27, 2014.

25. Kass, M.D.; Janke, C.J.; Theiss, T.; Pawel, S.; Baustian, J.; Wolf, L.; Koch, W.; Compatibility Assessment of Plastic Infrastructure Materials to Test Fuels Representing Gasoline Blends Containing Ethanol and Isobutanol. *SAE Intl., J. Fuels Lubr.,* Volume 7, Issue 2, June 2014.

26. Kass, M.D.; Janke, C.J.; Theiss, T.; Pawel, S.; Baustian, J.; Wolf, L.; Koch, W.; Compatibility Assessment of Elastomer Materials to Test Fuels Representing Gasoline Blends Containing Ethanol and Isobutanol. *SAE Intl., J. Fuels Lubr.,* Volume 7, Issue 2, 2014.

27. Kim, J.; Tsouris, C.; Oyola, Y.; Janke, C.J.; Mayes, R.T.; Dai, S.; Gill, G.; Kuo, L.J.; Wood, J.; Choe, K.Y.; Schneider, E.; Lindner, H.; Uptake of Uranium from Seawater by Amidoxime-Based Polymeric Adsorbent: Field Experiments, Modeling, and Updated Economic Assessment. *Ind. Eng, Chem. Res.,* **2014**, 53 (14), 6076-6083.

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1. The Register – Aug. 22 – Lewis Page (United Kingdom)
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   http://www.theregister.co.uk/2012/08/22/oceanic_uranium_mining_tech/print.html

2. C&EN (Chemical & Engineering News) - Sept. 3, Vol. 90, No. 36, p. 60 - Mitch Jacoby - 847-679-1156 (see Sept. 5 email)
   Extracting Uranium From Seawater
   http://cen.acs.org/articles/90/i36/Extracting-Uranium-Seawater.html

3. International Mining – Aug. 28
   ORNL technology moves scientists closer to extracting uranium from seawater
   http://www.im-mining.com/2012/08/

4. World Nuclear News – Aug. 23
   The sea is the key to uranium bounty
   http://www.world-nuclear-news.org/ENF_The_sea_is_the_key_to_uranium_bounty_2308121.html

5. TG Daily – Aug. 22 – Emma Woolacott
   Nuclear power could come from the oceans

http://www.tgdaily.com/sustainability-features/65604-nuclear-power-could-come-from-the-oceans

6. Examiner – Aug. 22 – David Herron – greentransportation@gmail.com
Extracting uranium from oceans offers a mixed bag of possibilities
http://www.examiner.com/article/extracting-uranium-from-oceans-offers-a-mixed-bag-of-possibilities

7. The Engineer – Aug. 22 – United Kingdom
Material could economically extract uranium from water
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8. ORNL Press Release – Aug. 21 – Ron Walli – 576-0226
ORNL Technology moves scientists closer to extracting uranium from seawater
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9. Inside Energy – Aug. 27 – Derek Sands
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