

# FORCON INTERNATIONAL

ROY CROOKS, Ph.D., P.E.

## SUMMARY

**Scientist and Professional Engineer** with broad experience in Forensic Engineering and Research and Development, education in Chemistry, Biology, Physics and Materials Science, and Classroom Instruction. Current User at three Federal Labs and four University Labs.

**Forensic Engineering:** Consultant to FORCON International, Richmond, VA. Materials Scientist, Electron Microscopist and Spectroscopist. Expert Witness for claims of faulty materials and applications.

**Classroom Instruction:** More than 500 hours of lecturing experience as an Adjunct Professor in Materials Science in the Mechanical Engineering Department of the Naval Postgraduate School (Monterey, CA).

### **Government and University Lab Affiliations:**

NASA LaRC, Hampton, VA, Advanced Materials and Processing Branch, under a reimbursable Space Act Agreement. Capability for Structure, Processing and Property studies of any material, technical resources and support staff and engineering inspection location,

Jefferson National Accelerator Facility, Newport News, VA, under a Cooperative Research and Development Agreement with Particle Accelerator Group and Materials Research Groups (with user access).

National High Magnetic Field Laboratory, Tallahassee, FL; Visiting Scientist, materials research labs. User access for specialized instrumentation.

Current user agreements with Virginia Commonwealth University, Old Dominion University, Florida State University and University of California, Irvine.

Work history with Lawrence Berkeley Laboratory, Oak Ridge National Laboratory, Deutsches Elektronen Synchrotron (DESY, Hamburg) and Fermilab.

## EDUCATION

**Professional Metallurgical Engineer**, 2004, Virginia, License No. 0402037657

**Ph.D. School of Chemical Engineering**, 1982, Georgia Institute of Technology, Atlanta, GA. Minor in Corrosion of Biomaterials. Specialized in electron microscopy, spectroscopy and fracture analysis. DARPA funding.

**M.S. Physical Metallurgy (Metal Physics)**, 1979 (School of Chemical Engineering), Georgia Institute of Technology, Atlanta, GA. More than 30 semester hours in Materials Science, emphasizing microscopy and corrosion. Thesis on superplastic forming. NSF funding.

**B.S. Applied Physics**, 1976, Georgia Institute of Technology, Atlanta, GA. Broad technical curriculum with 20+ semester hours each in Physics, Biology, Chemistry and Mathematics. Biophysics Option.

## PROFESSIONAL EXPERIENCE

### **FORCON International – Independent Engineering Consultant**

Specializing in Materials Science, Forensic Engineering, Instrumental Analysis. Expert in Failure Analysis for Consumer Products, Marine Hardware, Construction Materials.

**Black Laboratories, L.L.C., Newport News, VA, Principal Engineer**, 2004 - present. Company founder and Principal of engineering consulting and research firm. Hiring and supervision of scientists, engineers and support staff. Principal Investigator for DHS USCG IDIQ Contract. Consultant to Jefferson National Accelerator Facility,

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Fermilab, DESY (Hamburg), and NASA LaRC. Proposal Author and Principal Investigator for twelve R&D grants and contracts on spacecraft alloys, superconducting, accelerator cavities, electrochemistry, thin films, and corrosion-resistant alloys. **DOE, NASA, NASA/NESC, AFOSR, NavAir, CRCF (Commonwealth of VA) and DHS Funding.**

**Lockheed-Martin and AS&M Contractor, Senior Scientist and Staff Engineer**, 1994-2004. Studies of aerospace alloys. R&D 100 Award (2001) co-recipient for a new, alloy retrofit to a Lockheed-Martin Fighter Aircraft. High Resolution Microscopy, Spectroscopic Studies of nanomaterials at NASA LaRC and ORNL. **NASA Funding.**

**Naval Postgraduate School, Monterey, CA, Adjunct Professor**, 1990 – 1994, Mechanical Engineering Department. Lecturer for graduate courses in Materials Science, Phase Transformations, Welding and Corrosion. Navy research in metals processing. NavAir research using organosilane coating to avoid E-2C fuel nozzle coking problem. Research on welding methods for NASA Space Shuttle Superlightweight Tank. Thesis advisor and co-advisor for military officer graduate students. NSF Materials Research Science and Engineering Center Reviewer. **NavAir and NASA Funding.**

**Rockwell International Science Center, Thousand Oaks, CA. Member of the Technical Staff**, 1985 - 1990. Processing, deformation and fracture studies of aluminum and nickel alloys. Work at Lawrence Berkeley on coatings for hypervelocity aircraft. Principal Investigator for superplastic alloys. Degradation studies of Space Shuttle main engine bearings. Work at LBL, ORNL. **DARPA/AFML and LBL Funding.**

**ARCO Metals Technical Center, Atlantic Richfield Corporation, Arlington Heights, IL. Research Metallurgist**, 1983 - 1985. Group Leader, Electron Microscopy. Process improvement studies for corporate products: alloys, coatings, and composites. **Internal Corporate Funding.**

**Georgia Tech Fracture and Fatigue Research Laboratory, Graduate Research Assistant, Atlanta, GA**, 1976-1982. Fatigue and fracture studies of Al-Li alloys. Alloy development. Instructor for electron microscopy laboratories. Research at ORNL. **NSF and DARPA Funding.**

**Dunn Laboratories, Inc., Atlanta, GA, Chemist/Technician/Student**. 1974-1976. Wet chemistry, ASTM tests. Assistant to Expert Witness and Professional Engineer specializing in failures of tires and other automotive components.

## **FORENSIC INVESTIGATIONS**

- Architectural Plate Glass Damage Source Identification
- Cavitation Corrosion Failure of Large Industrial Pipes
- Corrosion Failure of Through-Hull Fixture and Sinking of Ocean Vessel
- Corrosion of Steel by Microbiologically Influenced Corrosion
- Domestic Roof Penetration by Airborne Steel Rod
- Double Fault Failure of Plumbing Fixture Leading to Whole House Flooding
- Fatigue Failure Leading to Dismasting of Large Luxury Sailing Yacht
- Fatigue Failure Leading to Dismasting of Racing Yacht
- Fatigue Failure of Army Helicopter Rotor Lag Straps
- Fatigue Failures of USCG Stainless Steel Cables
- Fatigue Fracture Leading to Porch Swing Support Failure and TBI
- Fracture of Commercial Steel Gate Hinges Leading to TBI
- Fracture of NASA Titanium Satellite Mounting Bolts
- Fracture Study of large BLEVE Boiler Failure
- Fracture of Polymer Water Filter Canister Leading to Flooding
- Fire Protection Sprinkler System Corrosion Failures
- FTIR and SEM Identification of Contaminants in USCG Aircraft Fuel Tank
- FTIR Identification of Alkyd Coating Related to Slip and Fall
- FTIR Identification of Food Substance Related to Slip and Fall

- FTIR Identification of Polymer Plumbing Failure by Fungal Attack
- FTIR Identification of Failed Polymer Component Resulting in Flooding
- Impact Failure of Truck Power Steering Pitman Arm in Fatal Accident
- Marine Diesel Engine Bearing Failure
- NASA Investigations of External Tank Cracking
- NASA SEM/EDS Study of \$443MM Tethered Satellite Loss on STS-75
- NASA Space Shuttle Columbia Crash Investigation
- NASA Space Shuttle Superlightweight Tank Weld Fracture Mitigation
- CNG Truck Fire Investigation and Study of Hydraulic Line Braze Failure
- Stress Corrosion Cracking of Multiple Brass Industrial Valves
- Stress Corrosion Cracking of Multiple Brass Plumbing Fixtures
- Thermal Breakdown in the Superconducting European X-ray Free Electron Laser
- Turbine Engine Component Failure in USCG Aircraft
- Turboprop Fuel Injector Malfunctions Due to Thermal Soakback Coking

## **CONTINUING EDUCATION COURSES**

ABYC: Basic Marine Electrical and Corrosion Mitigation (2018)

## **PROFESSIONAL SOCIETIES**

ASM International, The Minerals, Metals & Materials Society (TMS), The Microscopy Society of America. (MSA).

## **GRANTS WON FOR PROPOSALS - SMALL BUSINESS RESEARCH**

### **Metal Forming**

2004-2010 DOE Phase I, II and III SBIR

Production of Seamless Superconducting Radio Frequency Cavities from Ultra-Fine-Grained Niobium; Grant No. DE-FG02-04ER83909

### **Corrosion Resistant Alloys**

2009 OSD/ONR/NAWC SBIR

Highly Corrosion Resistant Aluminum Alloys: An Innovative Processing Method to Enhance Corrosion Resistance; Resistance Award No.: N00014-09-M-0401

### **Deformation and Fracture**

2011 NASA SBIR

Modeling-Based Processing of Al-Li Alloys for Delamination Resistance; Contract No. NNX11CH14P

### **Electropolishing**

2006 DOE SBIR

Engineered Surface Treatments for ILC Cavities; Grant No. DE-FG02-06ER84453

### **2008 DOE SBIR**

Green Electropolishing for Niobium SRF Cavities; Grant No. DE-FG02-07ER84746

### **Forensic Engineering**

2011 USCG - IDIQ

Analytical Capabilities (Aircraft); Contract No. HSCG38-11-D-500001

### **Superconducting Thin Films**

2008 DOE SBIR

Templated Niobium Films for SRF Cavities; Grant No. DE-FG02-08ER85165

2009 DOE STTR

Multilayer ALD Films for SRF Cavities; Grant No. DE-SC0000965

## **Superconducting Radio Frequency Cavities**

2011 Commonwealth Research and Commercialization Fund

Processing and Testing of Hydroformed SRF Cavities; CRCF Award Number CP-008

## **RESEARCH AWARDS FROM NASA THROUGH THE NATIONAL INSTITUTE FOR AEROSPACE**

### **Al-Li Alloys**

NIA Researcher Agreement C04-2000-REC, 2007-2010; Activity 2603/2703

2011 NASA/NIA/NESC Space Shuttle External Tank Stringer Fracture

NIA Subaward, 2011, No. C11-2703-BL

### **Nanomaterials**

NIA Researcher Agreement C04-2000-REC, 2004-2010; Activity 2381

## **PUBLICATIONS AND ONLINE PRESENTATIONS (within the last 10 years)**

### ***Plastic Deformation and Fracture***

1. Wesley A. Tayon, Kelly E. Nygren, **Roy E. Crooks**, Darren C. Pagan, *In-situ Study of Planar Slip in a Commercial Aluminum-Lithium Alloy using High Energy X-ray Diffraction Microscopy*, Acta Materialia, Volume 173, July 2019, Pages 231-241.
2. Robert S. Piascik, et al., "Space Transportation System (STS)-133/External Tank (ET)-137 Intertank (IT), Stringer Cracking Issue and Repair Assessment: Proximate Cause Determination and Material Characterization Study," NASA/TM-2011-217318, NESC-RP-10-00680, December 2011.
3. W. A. Tayon, **R. E. Crooks**, M. S. Domack, J. A. Wagner, A. J. Beaudoin, and R. J. McDonald, *Mechanistic Study of Delamination Fracture in Al-Li Alloy C458*. Proceedings 12th International Conference on Fracture (ICF) 2009, 2009.

### ***Superconducting Materials***

1. W. Singer, X. Singer, S. Aderhold, A. Ermakov, K. Twarowski, **R. Crooks**, M. Hoss, F. Schölz, F., and B. Spaniol, *Surface investigation on prototype cavities for the European X-ray Free Electron Laser*. Physical Review Special Topics - Accelerators and Beams, 2011. 14(5): p. 050702.
2. Diefeng Gu, Kandabara Tapily, Helmut Baumgart, and **Roy Crooks**, *Synthesis of NbN Thin Films for Superconducting Radiofrequency (SRF) Applications by Atomic Layer Deposition to Fabricate Superconductor-Insulator-Superconductor (S-I-S) Layers*. ECS Transactions, 2010. 33(203): p. 1444-1444.
3. Xin Zhao, A. M. Valente-Feliciano, C. Xu, R. L. Geng, L. Phillips, C. E. Reece, K. Seo, **R. Crooks**, M. Krishnan, A. Gerhan, B. Bures, K. Wilson Elliott, and J. Wright, *Large crystal grain niobium thin films deposited by energetic condensation in vacuum arc*. Journal of Vacuum Science and Technology A: Vacuum, Surfaces, and Films, 2009. 27(4): p. 620-625.
4. Tarek M. Abdel-Fattah and **Roy Crooks**, *Surface Characterization of High Purity Niobium Electropolished with an Ionic Liquid*. ECS Transactions, 2010. 33(7): p. 571-574.

### ***Nanomaterials***

1. Michael W. Smith, Kevin C. Jordan, Cheol Park, Jae-Woo Kim, Peter T. Lillehei, **Roy Crooks**, and Joycelyn S. Harrison, *Very long single- and few-walled boron nitride nanotubes via the pressurized vapor/condenser method*. Nanotechnology, 2009. 20.
2. Yi Lin, Kent A. Watson, Michael J. Fallbach, Sayata Ghose, Joseph G. Smith, Donavon M. Delozier, Wei Cao, **Roy E. Crooks**, and John W. Connell, *Rapid, Solventless, Bulk Preparation of Metal Nanoparticle-Decorated Carbon Nanotubes*. ACS Nano, 2009. 3(4): p. 871-884.

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3. Yi Lin, Kent A. Watson, Sayata Ghose, Joseph G. Smith, Tiffany V. Williams, **Roy E. Crooks**, Wei Cao, and John W. Connell, *Direct Mechanochemical Formation of Metal Nanoparticles on Carbon Nanotubes*. The Journal of Physical Chemistry C, 2009. 113(33): p. 14858-14862.

## **Online Presentations**

1. **Roy Crooks**, Waldemar Singer, RRR Niobium Seamless Cavities, The Fourth International Workshop on *THIN FILMS AND NEW IDEAS FOR PUSHING THE LIMITS OF RF SUPERCONDUCTIVITY* October 4 – 6, 2010, Legnaro National Laboratories, Padua, Italy.
2. **R. Crooks**, *Fabrication of ILC Cavities from Axisymmetric RRR Nb Tube*, US Hydroforming Workshop, Fermilab, Batavia, IL, September 1, 2010
3. **R. Crooks**, *Fabrication of ILC Cavities from Axisymmetric RRR Nb Tubes*, 6th SRF Materials Workshop, National High Magnetic Field Laboratory, Tallahassee, FL, February 18-20, 2010.
4. C.Z. Antoine, **R. Crooks**; *Reducing Electropolishing Time with Chemical-Mechanical Polishing*, Proceedings of SRF 2009, Berlin, Germany, 2009. Poster, [http://epaper.kek.jp/srf2009/posters/tuppo071\\_poster.pdf](http://epaper.kek.jp/srf2009/posters/tuppo071_poster.pdf).