



Exponent[®]
Engineering & Scientific Consulting

Zhuhua Cai, Ph.D., P.E.

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Professional Profile

Dr. Cai has a core competency in chemical engineering, with a focus toward electrochemistry and materials science. Dr. Cai specializes in synthesis, fabrication and testing of composite oxide/ceramic systems for electrochemical energy storage applications. She has extensive academic and industrial experience in developing and characterizing electrode materials for fuel cells and lithium-ion batteries. She is also experienced in employing design of experiments and failure analysis to resolve process, product and performance issues. This broad engineering background enables her to provide support to clients from a variety of markets.

Dr. Cai is skilled in a variety of electrochemical analyses including cyclic voltammetry (CV), impedance (EIS), and cycle life testing. She also has extensive experience in ceramic thin film and bulk material characterization techniques including chemical spectroscopy (XPS, AES, EDS, Raman), Focused Ion Beam (FIB), Electron Microscopy (TEM/SEM), scanning probe microscopy (AFM, STM, and MFM), X-ray diffraction (XRD), N₂ Adsorption (BET) and Thermogravimetric Analysis (TGA). Dr. Cai has more than ten years of direct hands-on experience in thin film deposition (e.g. sputtering, pulsed laser deposition, and molecular beam epitaxy) and micro-fabrication (lithography, reactive ion etching, lift-off, and wet etching). Dr. Cai is also proficient in fuel cell and lithium-ion cell fabrication techniques including powder/slurry preparation, ball milling, drying, tape casting, calendaring, calcination, sintering and screen-printing.

Prior to joining Exponent, Dr. Cai worked as research scientist in Prof. Yet-Ming Chiang's group at MIT developing low cost electrolyzers. She also worked as Senior Process Engineer and R&D Engineer in SiEnergy Systems and 24M Technologies respectively, where she developed new structures of ceramic oxides for high temperature fuel cell electrodes and optimized manufacturing processes for making lithium-ion batteries. She routinely employed root cause analysis to understand the fundamental degradation and failure mechanisms for high temperature solid oxide fuel cells (SOFC). Dr. Cai also previously worked as a Postdoctoral Associate in Prof. Bilge Yildiz's group at MIT to improve the efficiency and durability of SOFCs by developing highly active cathode materials and nano-structures.

Academic Credentials & Professional Honors

Ph.D., Chemical Engineering, Northeastern University, 2010

B.S., Chemical Engineering, East China University of Science and Technology, 1999

Licenses and Certifications

Licensed Professional Chemical Engineer, California, #6999

Prior Experience

Research Scientist, MIT, 2016-2017

Senior Process Engineer, 24M Technologies, 2016

Senior R&D Engineer, SiEnergy Systems, 2013-2015

Postdoctoral Associate, MIT, 2010-2012

Professional Affiliations

Materials Research Society — MRS

The Electrochemical Society — ECS

American Institute of Chemical Engineers-AICHE

Languages

Mandarin Chinese

Publications

Kubicek M, Cai Z, Ma W, Yildiz B, Fleig J. Tensile lattice strain accelerates oxygen surface exchange and diffusion in $\text{La}_{1-x}\text{Sr}_x\text{CoO}_{3-\delta}$ thin films. *ACS Nano* 2013; 7:3276-3286.

Chen Y, Cai Z, Kuru Y, Ma W, Tuller HL, Yildiz B. Electronic activation of cathode superlattices at elevated temperatures - source of markedly accelerated oxygen reduction kinetics. *Advanced Energy Materials* 2013; 3:1221-1229.

Lee W, Han JW, Chen Y, Cai Z, Yildiz B. Cation size mismatch and charge interactions drive dopant segregation on the surfaces of manganite perovskites. *Journal of the American Chemical Society* 2013; 135:7909-7025.

Cai Z, Kubicek M, Fleig J, Yildiz B. Chemical heterogeneities on $\text{La}_{0.6}\text{Sr}_{0.4}\text{CoO}_{3-\delta}$ thin films — Correlations to cathode surface activity and stability. *Chemistry of Materials* 2012; 24:1116-1127.

Chen Y, Jung W, Cai Z, Kim J, Tuller HL, Yildiz B. Impact of Sr segregation on the electronic structure and oxygen reduction activity of $\text{SrTi}_{1-x}\text{Fe}_x\text{O}_3$ surfaces, *Energy & Environmental Science* 2012; 5:7979-7988.

Cai Z, Kuru Y, Han JW, Chen Y, Yildiz B. Surface electronic structure transitions at high temperature on perovskite oxides: The case of strained $\text{La}_{0.8}\text{Sr}_{0.2}\text{CoO}_3$ thin films. *Journal of the American Chemical Society* 2011; 133:17696-17704.

Kuru Y, Jalili H, Cai Z, Yildiz B, Tuller HL. Direct probing of nano-dimensioned oxide multilayers with aid of focused ion beam milling. *Advanced Materials* 2011; 23:4543-4548.

Jalili H, Han JW, Kuru Y, Cai Z, Yildiz B. New Insights into the strain coupling to surface chemistry, electronic structure and reactivity of $\text{La}_{0.7}\text{Sr}_{0.3}\text{MnO}_3$. *The Journal of Physical Chemistry Letters* 2011; 2:807-810.

Presentations

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Cai Z, Kubicek M, Fleig J, Yildiz B. Influence of lattice strain on the oxygen exchange kinetics and oxide ion diffusion in $(\text{La,Sr})\text{CoO}_{3-\delta}$, Oral Presentation, Material Research Society Conference, Boston, MA, 2012.

Cai Z, Chen Y, Yildiz B. Cation segregation and electrochemical activity of ruddlesden popper phase cobalt oxides in oxygen reduction and oxygen evolution. Oral Presentation, 222nd Electrochemical Society Meeting, Honolulu, Hawaii, 2012.

Cai Z, Kubicek M, Januschewsky J, Fleig J, Yildiz B. Effect of temperature on the surface cation chemistry of $\text{La}_{0.6}\text{Sr}_{0.4}\text{CoO}_3$ Thin Films - correlations to cathode performance. Poster Presentation, 18th International Conference on Solid State Ionics, Warszawa, Poland, 2011.

Cai Z, Sun B, Ziemer KS. Integration of barium hexaferrite on wide bandgap semiconductor 6H-SiC by molecular beam epitaxy, Poster Presentation, North American Molecular Beam Epitaxy Conference, Princeton, NJ, 2009.

Cai Z, Chen Z, Harris VG, Ziemer KS. Molecular beam epitaxy integration of barium hexaferrite on wide bandgap semiconductor 6H-SiC. Oral Presentation, American Vacuum Society Meeting, Boston, MA, 2008.

Cai Z, Goodrich TL, Ziemer KS. Understanding the role of the magnesium oxide interlayer on heteroepitaxial growth of barium hexaferrite on 6H-SiC, Oral Presentation, North American Molecular Beam Epitaxy Conference, Albuquerque, NM, 2007.