Anhua Dong

PhD Candidate in Chemical Engineering
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EDUCATION

PhD in Chemical Engineering — Expected July 2022
University of South Carolina, Columbia, SC
Committee**:** John R. Regalbuto (advisor), John Monnier, Christopher Williams, Aaron Vannucci

M.E. in Chemical Engineering — 06/2016
Tianjin University, China

B.E. in Chemical Engineering and Technology — 06/2013
Shandong Normal University, China

EXECUTIVE SUMMARY

- Self-motivated and result-driven material scientist in the design, synthesis and characterization of inorganic materials with controlled physical/chemical properties, such as tunable particle size, various structures (core-shell, homogenous alloys, single atoms, multi-functional sites, etc.; which exhibit high performance in heterogenous catalysis and have great potentials as energy-storage battery materials.
- 8+ years' experience in the experiments design and executing, equipment set-up and maintenance, data collection and analysis, including development, synthesis characterization of nanomaterials with controlled physical/chemical properties; built-up batch/flow reactors to evaluate the prepared materials, e.g. oxidation, dehydrogenation, biomass conversion, etc.; data analysis in elements contents, particle size, surface active site, cluster structures, reaction mechanism, catalytic kinetics, activity-structure function, etc.
- 1-year industrial experience in the scale-up synthesis of spherical alumina with varied surface area in an oil company.
- 2-year experience in computational simulation by MatLab and ASPEN.
- Instrument skills: powder XRD, TEM, SEM/EDS, ICP-OES, FTIR, UV-vis, XRF, XPS, AA, BET, TPR/TPD/TPO/chemisorption, batch/flow reactor, GC-MS, TGA-DSC, MatLab, Aspen, C/C++, etc.
- Excellent written and oral communication skills (8 publications, 7 presentations in the well-known national/international conferences).
- Strong problem-solving ability; a good team player; excellent leadership and organization skills.

WORK EXPERIENCE

Research Assistant at University of South Carolina — 08.2017-present

- Developed Pd-acid bifunctional nanomaterials with ultra-small NPs and tunable acid sites; designed batch reaction of 1-methyl guaiacol under mild conditions to study the function of molar ratio of Pd/acid sites.
- Designed PdAu bimetallic nanomaterials with homogenous alloys on silica and alumina; diluted surface Pd concentration to single-atom scale; built up batch reaction of primary oxidation, and evaluated the relationship of surface Pd concentration to the activity.
- Set up *in-situ* FTIR experiments to revisit the evolution of gold anions on non-reducible support; studied the effects of thermal-chemical pretreatments; built-up flow reactor and investigated the activity of gold anions in CO combustion at room temperature.
- Designed mono- or bimetallic (Pd, Pt, Co, Ni, Cu) nanomaterials with varied particle sizes by using SEA, CEDI, DI methodologies; and investigated the effects of metal precursors and washing steps on the particle size.
- Simulated metal adsorption in SEA process by computational approaches (MatLab); and optimized the parameters on the interaction of adsorption process in catalyst synthesis.
- Synthesized monometallic Pd, Au, Pt nanomaterials on silica for particle size analysis with rietveld refinement by XRD analysis via using TOPAS.

- Coating alumina film onto silica particles by ALD and MLD methods.

Teaching Assistant at University of South Carolina 08.2017-12.2019

- Assisted in teaching courses of Chemical Process Dynamics, Chemical Engineering Kinetics, Process Safety Health and Loss Prevention, Separation Process Design.

Research Assistant at Tianjin University 08.2013-06.2016

- Developed and synthesized alumina-beads with tunable surface area in water-column.
- Built up a fixed bed reaction system to evaluate the catalytic performance of the prepared PtSn catalysts in isobutane dehydrogenation; investigated the function of catalysts surface area.
- Chemical separation simulation by APSEN-PLUS.

Intern in CenerTech Tianjin Chemical Research and Design Institute Co., Ltd, China 09.2014-08.2015

- Participated in the scale-up experiments in the synthesis of spherical alumina in water-column.

Intern in Mingshuidahua Chemical Co., Ltd, China 03.2013-04.2013

- Learned the entire production process of urea fertilizer and the data acquisition as well as optimization.

RESEARCH EXPERIENCE

Research in University of South Carolina 08/2017-present

(i). New insights on the formation of gold anions on SiO_2 and the activity in CO oxidation. 03/2020-present

- Synthesized 1.6nm (by SEA) and 11nm (by DI) Au nanoparticles on SiO_2.
- Designed *in-situ* FTIR experiment to surveil the evolution of gold anions in various thermal-chemical pretreatments.
- Built-up flow reaction to investigate the activity of $Au^{\delta-}$ in CO oxidation and analyzed reaction mechanism.

(ii). Single-atom catalysts with ultra-small PdAu NPs and the utilization for 1-phenylethanol oxidation 04/2019-05/2020

- Diluting Pd atoms into Au clusters from molar ratio of Pd:Au=1:1 to 1:120 by SEA recipe, achieved single Pd atoms and Pd rich surface.
- Set up *in-situ* FTIR and CO chemisorption and studied the physical/chemical properties of surface Pd atoms.
- PdAu sample with Pd:Au=1:60 performed the best in the oxidation of 1-phenylethanol.

(iii). Homogeneous PdAu alloys for primary alcohol oxidation 01/2019-12/2020

- Synthesized ultra-small PdAu NPs (<1.5nm) with homogeneous alloys on SiO_2 and γ-Al_2O_3 via co-SEA method.
- Designed a batch reactor to evaluate the activity of PdAu alloys in benzyl alcohol oxidation.
- Analyzed reaction mechanism, kinetics and composition-function in the activity.

(iv). Catalysis for renewables: Bifunctional nanomaterials for biomass conversion 01/2018-05/2019

- Prepared metal-acid bifunctional nanomaterials with ultra-small (~1 nm) Pd NPs or big (5-21nm) Pd particles.
- Set up batch reaction of hydrodeoxygenation of methyl-guaiacol under mild conditions.
- Analyzed the function of molar ratio of Pd/acid sites, reaction mechanism and kinetics.
- Investigated on coating alumina film onto silica particles and analyzed the film properties.

(v). Synthesized tunable size of mono-/inter-metallic, precious/nonprecious (Pt, Pd, Cu, Ni, Co) nanomaterials by adjusting the interaction between metal precursors and support in the electrostatic adsorption process. 03/2018-09/2018

(vi). Simulation in the thermodynamics analysis in the metal-support interaction of SEA method by MatLab and optimized the conditions in nanomaterial synthesis. 02/2019-02/2021

(vii). The extension of Rietveld refinement for benchtop powder XRD analysis of ultra-small metal nanoparticles. 05/2019-09/2021

(viii). Investigation of humidity, light, oxidation, or organic remnants on the sintering of of ultra-small noble metal (Pd, Pt, Au) nanoparticles, including. 05/2021-present

Research in Tianjin University 08/2013-06/2016

(i). Synthesis of spherical alumina and its application for isobutane dehydrogenation.

- Prepared spherical alumina by sol-gel method through gelation reaction between ammonium alginate with Ca^{2+} cation.
- Spherical alumina with controlled textural structure were achieved by adding specific amounts of liquid paraffin as pore-enlarge agent.
- PtSn catalysts over alumina beads with various surface area were synthesized and investigated the activity in isobutane dehydrogenation.

(ii). Scale-up experiment of producing spherical alumina in an oil company.

- Optimized the experimental parameters (ratio of pseudo-boehmite to ammonia alginate, exciter speed, water flow rate, time in nitric acid solution, etc.) to get shaped alumina beads with high strength.

(iii). ASPEN simulation in chemical separation of methanol, ethanol, propyl alcohol and water mixture.

SKILLS

- **Techniques in Nanomaterial Synthesis**: nanomaterials with ultra-small particles (<1nm) can be obtained via Strong Electrostatic Adsorption; medium small nanoparticles (5-10nm) via charge enhanced, large particles (>10nm) prepared by incipient wet impregnation.
- ***Equipment Utilization***: powder XRD, STEM, SEM, XPS, FTIR, UV-vis, ICP-OES, GC-MS, BET, atomic absorption spectroscopy (AA), TPD/TPR/TPO, chemisorption, batch/flow reactor, etc.
- ***Simulation/Data Analysis Tools:*** MatLab, Aspen, fityk/TOPAS, Particle 2/Image J/Gatan, GC, OMNIC, Origin, XPSPEAK, Chemdraw, Microsoft, etc.

PUBLICATIONS

- Revisit Negatively Charged Au Species on Non-reducible Support and the activity in CO oxidation, Anhua Dong, John. R. Regabulto, Christopher Williams, in preparation for ACS Catalysis.
- Pinch Single Atoms in Homogenous PdAu Alloys on SiO_2 Prepared by Electrostatic Adsorption. in preparation, Anhua Dong, Abolfazl Shakouri, Stavros Karakalos, Douglas A. Blom, John. R. Regabulto, in preparation.
- A Simple, Generalizable Synthesis of Homogenous PdAu alloys for Solvent-free Benzyl Alcohol Oxidation, Anhua Dong, Douglas A. Blom, John R. Regalbuto. in preparation.
- Supported Metal-Acid Bifunctional Catalysts Synthesized by Electrostatic Adsorption of Pd onto Metal-Doped Silicas, Anhua Dong, Jake Tillou, John Meynard Tengco, Ananad Ramanthan, John R. Regalbuto. in preparation
- Pushing the limits of electrostatic adsorption: charge enhanced dry impregnation of SBA-15. Sonia, Eskandari, Anhua Dong, Leandro T.De Castro, Fahim Bin Abdur Rahman, Jeremiah Lipp, Douglas A. Blom, John R. Regalbuto, Catalysis Today 338 (2019) 60-71. doi.org/10.1016/j.cattod.2019.06.082
- The Extension of Rietveld Refinement for Benchtop Powder XRD Analysis of Ultra-Small Supported Nanoparticle, Jeremiah Lipp, Ritubarna Banerjee, M.D. Fakhruddin Patwary, Nirmalendu Patra, Anhua Dong, Frank Girsdies, Simon R. Bare, J. R. Regalbuto. under review from Chemistry of Materials.
- Facile preparation of PtSn-La/Al_2O_3 catalyst with large pore size and its improved catalytic performance for isobutane dehydrogenation, Anhua Dong, K. Wang, S.Z. Zhu, G. B. Yang, X. T. Wang, Fuel Processing Technology 158 (2017) 218–225. doi.org/10.1016/j.fuproc.2017.01.004

PRESENTATIONS & CONFERENCE

- Synthesis of Ultra-Small PdAu Nanoparticles with Homogenous Alloys on SiO_2 and Al_2O_3 Via Electrostatic Adsorption, NAM 2022.
- New Insights of Thermal-chemical Pretreatments on Gold Anions on SiO_2, AICHE 2021.
- Supported Metal-Acid Bifunctional Catalysts Synthesized by Electrostatic Adsorption of Pd onto Metal-Doped Silicas, ACS 2021.
- A Simple, Generalizable Synthesis of PdAu/SiO_2 Single Alloy Catalysts, CECS 2021.
- Study of CO Adsorption on Au/Silica Reduced at Elevated Temperatures, CerCas 2021.

- Preparation of PdAu Bimetallic Catalysts on Mesoporous Silica or Gamma Alumina by Strong Electrostatic Adsorption, CerCas 2019.
- Pushing the Limits of Electrostatic Adsorption: Charge Enhanced Dry Impregnation, CECS 2019 fall.

Awards & HONORS

- The first prize scholarship, Tianjin University 2014-2016
- Outstanding Volunteer for 120th Anniversary celebration, Tianjin University 11/2015
- Outstanding graduate, Shandong Normal University 01/2013
- The first prize scholarship (3 times), Shandong Normal University 2010-2013
- Outstanding Student (3 times), Shandong Normal University 2010-2013
- National Inspirational Scholarship, The Ministry of Education of P.R. China. 10/2010