

Hongbo Zhang

1833 Orchard PL APT C, Urbana, IL, 61801

zhangh811@gmail.com; (630) 240-6286

EDUCATION	Dalian Institute of Chemical Physics (DICP), Dalian, China	2006.9 – 2012.5
	<i>PhD, Heterogeneous Catalysis with Prof. Xinhe Bao and Prof. Xiulian Pan</i>	
	Nankai University, Tianjin, China	2002.9 – 2006.6
	<i>B.S., Material Chemistry (Department of Chemistry)</i>	
EXPERIENCE	University of Illinois, Urbana-Champaign, Illinois	2016.2-present
	<i>Postdoc Associate, Chemical and Biomolecular Engineering Department,</i>	
	Advisors: Dr. David W. Flaherty	
	Topic: Thermal Dynamic and Kinetic Studies on C-C Bond Formation from Ethanol over Amphoteric Metal Oxides	
	<ul style="list-style-type: none">• Kinetics study, titrations/inhibition, <i>in-situ</i> FTIR measurement and Steady State Isotopic Transient Kinetic Analysis (SSITKA) were applied to investigate the pressure dependence of C-C bond formation over each molecule in the catalytic system, the most abundant surface intermediate (MASI), the rate determine step(s) of the C-C bond formation (aldol condensation) from ethanol with acetaldehyde as the key intermediate and the correlation between Lewis acid strength and the formation of the C-C bond.• EtOH/ethoxide was determined to be the MASI on the surface. Nucleophilic attack from enolate to the molecularly adsorbed acetaldehyde was determined to be the kinetically relevant step and was confirmed with thermodynamic isotopic effect by replacing acetaldehyde with perdeuterated acetaldehyde.• Strong correlation was determined between the C-C bond formation and the strong Lewis acid sites of TiO₂ catalysts.• Multi-steps of C-C bond formation was prevented by applying single site transition metal incorporated de-aluminated BEA catalyst. Strong correlations were identified between the C-C bond formation and the Lewis acid strength of single site catalysts applied (Ti-BEA, Ta-BEA, Nb-BEA and Zr-BEA), while not for the esterification, dehydration and hydrogen transfer reaction (Meerwein–Ponndorf–Verley reduction).	
	Pennsylvania State University, State College, Pennsylvania	2015.2-2016.2
	<i>Postdoc Associate, Chemical Engineering Department,</i>	
	Advisors: Dr. Robert M. Rioux	
	Topic: Acrylic Acid (AA) Production from Catalytic Dehydration of Lactic Acid (LA) over K⁺ Modified Zeolite	
	<ul style="list-style-type: none">• More than 80 % AA selectivity was determined at about 90 % LA over KH₂PO₄ modified Na/ZSM5 catalyst.• Deactivation mechanism was well investigated. Coke formation and de-alumination should be the main reasons for the deactivation.• Catalyst stability was improved either by steaming or silanization to make a hydrophobic surface over ZSM-5.	
	Argonne National Laboratory, Chicago, Illinois	2013.1–2015.2

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Postdoc Associate, Chemical Sciences and Engineering Division,

Advisors: Dr. Christopher L. Marshall

Topic: ALD modification of Cu based catalysts in furfural hydrogenation

- Achieved highly stable reaction performance over copper catalyst for furfural hydrogenation by applying a thin layer of Al₂O₃ over copper using atomic layer deposition (ALD). Influence from the ALD layers as well as the reaction mechanism were thoroughly studied with *in-situ/operando* XAS characterizations and kinetics study. The reaction performance was further improved by applying TiO₂ ALD.
- Improved the selectivity of furfural hydrogenation reaction with few cycles of alumina ALD overcoatings over Pd nanoparticles (NPs). Work proved that the step sites of the Pd NPs could be selectively covered, leaving the only terrace sites for furfural hydrogenation and leading to improved selectivity.

Dalian Institute of Chemical Physics (DICP), Dalian, China **2006–2012**

Graduate Research Assistant,

Advisors: Prof. Xinhe Bao and Dr. Xiulian Pan

Topic: Confinement effects of double-walled carbon nanotubes (DWNT) in catalysis

- Utilized the channel of DWNTs on heterogeneous catalysis study.
- Developed one gas phase method for decorating DWNT with various transition metals and metal oxides. (for example: TiO_x, VO_x, MoO_x, Si and Re(CH₃)O₃) Ultrafine dispersion for each material was achieved inside the channel of DWNT.
- Identified the electronic interactions between metal nanoparticles inside DWNTs channel and the carbon layers using *in-situ* and *ex-situ* spectroscopy (such as: XPS, XANES, HRTEM, STXM and Raman).
- Identified molecule enrichment effect inside DWNTs based on *in-situ* solid state NMR. Confirmed that the reaction of benzene hydroxylation would be obviously enhanced through a confined hydrophobic environment in carbon nanotubes, which might open a new dimension for a rational design of the novel catalysts.

PUBLICATIONS

- **Hongbo Zhang**, Yu Noda, Rajesh Dasari, Ramnik Singh, Joann Sutyak, Kaijin Lia, Yuriy Roman-Leshkov and Robert M. Rioux, Deactivation Mechanistic Studies of Potassium Phosphate Modified NaZSM5 Catalyst for Selective Dehydration of Lactic Acid; **in preparation**.
- **Hongbo Zhang** and David W. Flaherty, Thermal Dynamic and Kinetic Studies on C-C Bond Formation from Ethanol over Amphoteric Metal Oxides; **in preparation**.
- **Hongbo Zhang**, Christian Canlas, A. Jeremy Kropf, Jeffrey W. Elam, James A. Dumesic and Christopher L. Marshall, Enhancing the stability of copper chromite catalysts for the selective hydrogenation of furfural with ALD overcoating (II)----comparison between TiO₂ and Al₂O₃ overcoating; **J. Catal.** 326, 172-181 (2015).
- **Hongbo Zhang**, Xiangkui Gu, Christian Canlas, A. Jeremy Kropf, Jeffrey P. Greeley, Jeffrey W. Elam, James A. Dumesic, Peter C. Stair and Christopher L. Marshall,

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Atomic Layer Deposition Overcoating: Tuning Catalyst Selectivity for Biomass Conversion; **Angew. Chem. Int. Ed.** 53, 12132–12136 (2014).

- **Hongbo Zhang**, Yu Lei, A. Jeremy Kropf, Guanghui Zhang, Jeffrey W. Elam, Jeffrey T. Miller, Fred Sollberger, Fabio Ribeiro, Cem M. Akatay, Eric A. Stach, James A. Dumesic and Christopher L. Marshall, Enhancing the stability of copper chromite catalysts for the selective hydrogenation of furfural with ALD overcoating; **J. Catal.** 317, 284-292 (2014).
- Fan Zhang, Xiulian Pan, Yongfeng Hu, Liang Yu, Xiaoqi Chen, Peng Jiang, **Hongbo Zhang**, Shibin Deng, Jin Zhang, Trudy B. Bolin, Shuo Zhang, Yuying Huang, and Xinhe Bao, Tuning the redox activity of encapsulated metal clusters via the metallic and semiconducting character of carbon nanotubes; **Proc. Natl. Acad. Sci. U. S. A.** , 110, 14861-14866 (2013).
- **Hongbo Zhang**, Xiulian Pan and Xinhe Bao, Facile filling of metal particles in small carbon nanotubes for catalysis application; **J. Nature Gas Chemistry.** 22, 251-256 (2013).
- **Hongbo Zhang**, Xiulian Pan, Xiuwen Han, Xiumei Liu, Xuefeng Wang, Wanling Shen, and Xinhe Bao, Enhancing chemical reactions in a confined hydrophobic environment: an NMR study of benzene hydroxylation in carbon nanotubes; **Chem. Sci.** 4, 1075-1078 (2013)
- **Hongbo Zhang**, Jian Wang, Yongfeng Hu, Xiulian Pan and Xinhe Bao, Local structure of double walled carbon nanotube confined titania characterized by scanning transmission X-ray microscopy; **J. Chem. Phys.** 136, 174701 (2012)
- Weijie Gao, Shujing Guo, **Hongbo Zhang**, Xiulian Pan and Xinhe Bao, Enhanced Ammonia Synthesis Activity of Ru Supported on Nitrogen-Doped Carbon Nanotubes; **Chin. J. Cat.** 32, 1418-1423 (2011)
- Zhen Wang; Qiang Fu; Xuejun Xu; **Hongbo Zhang**; Wenliang Li; Min Gao; Dali Tan; Xinhe Bao, Controlled growth of metal-free vertically aligned CNT arrays on SiC surfaces **Chem. Phy. Lett.** 503,247-251 (2011).
- **Hongbo Zhang**, Xiulian Pan, Jingyue Liu, Weizhong Qian, Fei Wei, Yuying Huang and Xinhe Bao*, Enhanced catalytic activity of sub-nanometer titania clusters confined inside double-wall carbon nanotubes **ChemSusChem**, 4 (7), 975-980 (2011).

CONFERENCE

- 10th International Conference on the Science and Application of Nanotubes, Beijing, China, June 21-26, 2009
- The 4th International Symposium on carbon for catalysis, poster, Dalian, 2010.
- The 15th National Conference on Catalysis of China, poster, Guangzhou, China, Nov.28-Dec.2, 2010
- Annual World Conference on Carbon, oral, Shanghai, China, July 24-29, 2011
- Gordon Research Conference/ Catalysis, poster, New London, NH, USA, June 22-26, 2014 ----3rd best poster
- 24th North American Meeting (NAM) of the Catalysis Society, poster, Pittsburgh, PA, USA, June 14-19, 2015
- 253rd ACS National Meeting, oral presentation, San Fransisco, CA, USA, April 2-6, 2017

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AWARDS

- DICP-Corning Graduate Student Scholarship 2011
- Excellent student award of the year in DICP 2009
- Excellent student award of the year in DICP 2007