Catalysis Club of Philadelphia

Webinar: 12:00 PM EST/5:00 UK-London
Thursday, January 20th, 2022
Zoom link shared after registration

Speaker: Dr. Dave Thompsett

Johnson Matthey

Three-way catalysts: Innovation within a mature technology

Student Speaker: Bar Mosevitzky Lis

Meeting Schedule:

Welcome
12:00 PM EST/5:00 UK-London
Bar Mosevitzky Lis
12:30 PM/5:30 PM
Dr. Thompsett
1:00 PM/6:00 PM
Meeting adjourns
2:00 PM/7:00 PM

Meeting Fees:

Free to all who register

Meeting Etiquette:

Please remember to mute your microphone and arrive early to solve any technical issues. Camera sharing prior to the talks is encouraged.

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Online Registration – Please register online by Wednesday, January 19th at http://catalysisclubphilly.org/webinar-registration/ or Arrangements Chair, hrenjing@seas.upenn.edu.

A Zoom meeting invite will be provided through the confirmation email. If you do not receive a confirmation email immediately after registration, please contact Renjing Huang, hrenjing@seas.upenn.edu.

Membership – Dues for the 2021-22 season will be $25 ($5 for the local chapter and $20 for the national club). Dues for students, post-docs and retirees will be $10 ($5 for the local club and $5 for the national club).

Dave Thompsett

I obtained my PhD in Inorganic Coordination Chemistry from the University of Bath (in the UK) in 1987 and started at JM at their corporate research centre (JMTC) in 1986 initially working on fuel cell technology. I have worked on a wide range of catalytic and electrocatalytic technology in my time at JM including electrocatalysts for PEMFCs, DMFCs and PAFCs, fuel processing catalysis (HC reforming, WGS and PROx) and emission control catalysis (gasoline, diesel and stationary). Areas of particular interest have been materials synthesis, material characterisation, structure activity relationships, modelling and materials processing for application (e.g. colloidal science). Up to 2021, my role was the leader of the emission control research group based at JMTC in Sonning which comprised a team of 40+ research scientists and engineers. In April 2021, I move into a more science facing role as a Senior Research Fellow leading a small team of scientists working across JM's application areas in the area of materials.

A Paradigm Shift in the Nature of the Active Surface of the Bismuth Molybdate Catalyst during the Selective Oxidation of Propylene

Bar Mosevitzky Lis

Bulk, unsupported bismuth molybdate mixed oxide catalysts found wide application in the industrial production of acrolein/acrylonitrile from oxidation/ammoxidation of propylene since the early 1960s and revolutionized the textile manufacturing industry in a short period of time. Despite the significant impact of bismuth molybdate catalysts, in situ spectroscopic surface information vital to understanding the fundamental surface structure-performance relations of these catalysts has still not been established in the literature. In the present work, in situ near-ambient pressure X-ray photoelectron spectroscopy (NAP-XPS) is used to monitor the elemental composition and oxidation states in the near-surface region (~1-3 nm) of the α-Bi2(MoO4)3 catalyst under propylene oxidation reaction conditions. The in situ NAP-XPS measurements are complemented with in situ electron paramagnetic resonance (EPR) spectroscopy to confirm the generation of Mo5+ in the catalyst in the presence of propylene and in situ high sensitivity low-energy ion scattering (HS-LEIS) spectroscopy to determine the elemental composition of the outermost surface layer (~0.3 nm) and elemental depth profile down to ~1.2 nm of the dehydrated catalyst. The corresponding bulk-phase of the α-Bi2(MoO4)3 catalyst under reaction conditions is monitored with in situ Raman and X-ray diffraction (XRD) spectroscopies. The bulk phase of the α-Bi2(MoO4)3 catalyst is stable during propylene oxidation at elevated temperatures and even after 60

minutes of propylene in the absence of molecular O2. In contrast, the surface region is dynamic since Mo undergoes the Mo6+ ↔ Mo5+ redox cycle while Bi3+ is always present and does not undergo redox during the selective oxidation of propylene. Furthermore, the topmost layer of α-Bi2(MoO4)3 is significantly surface enriched in Mo. The pronounced surface enrichment of Mo and redox behavior of MoOx suggests that the surface Mo6+Ox sites are the catalytic active sites while the Bi3+ sites are not active sites and only indirectly participate as ligands that moderate the MoOx redox cycle in the selective oxidation of propylene. These new molecular level insights about the surface characteristics of α-Bi2(MoO4)3 catalysts during propylene oxidation reaction conditions are creating a paradigm shift of the previously proposed models for propylene oxidation by α-Bi2(MoO4)3 catalysts that are only based on knowledge of the bulk phase of the α-Bi2(MoO4)3 mixed oxide catalyst.

Bio

Bar Mosevitzky Lis is a Postdoctoral Research Associate in Professor Israel Wachs' Operando Molecular Spectroscopy & Catalysis Research Lab at Lehigh University. He joined the lab in 2020 after receiving his Ph.D. in Chemical Engineering from the Technion – Israel Institute of Technology. His research focuses on the elucidation of structure-activity relations in heterogeneous catalytic systems using in situ and operando characterization techniques that can guide the rational design of catalysts with enhanced performance.