Molecular Surface Science, Nanomaterials & Catalysis: Symposium in Honor of Gabor Somorjai at 80

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During the 2017 Spring meeting in San Francisco, CA of the American Chemical Society, the Colloid and Surface Chemistry Division sponsored (co-sponsored by the Catalysis Division) a symposium in honor of Professor Gabor Somorjai's 80th Birthday. The symposium, "Molecular Surface Science, Nanomaterials & Catalysis: Symposium in Honor of Gabor Somorjai at 80" was organized by Professors Seong H Kim and Robert M. Rioux, both of the Pennsylvania State University and alumni of Professor Somorjai's group. The symposia spanned 3.5 days with 44 presentations delivered by former graduate students and postdoctoral associates, colleagues, collaborators and close friends. The symposia was divided into a number of thematic sessions: (i) Surface Science is Alive and Well; (ii) Catalyst Design; (iii) Soft Interfaces; (iv) Catalysts for Selective Chemical Transformations; (v) Surface Science of Functional Interfaces; (vi) Technique Development in Interfacial Science and (vii) Electrons & Photons in Interfacial Science. The assembly of talks made for outstanding scientific discussions.

The celebration of Professor Somorjai's 80th birthday at the 253rd American Chemical Society meeting included a reception celebrating the career of Professor Somorjai. The event organized by the College of Chemistry at the University of California, Berkeley was attended by a large number of Somorjai group alumni. In addition to alumni and friends of the Somorjai group, a number of people dear to Professor

Somorjai were in attendance, including his wife, Mrs Judith Somorjai, his daughter, Dr. Nicole Alivisatos, his son-in-law, Professor Paul Alivisatos and long-time administrative assistant, Ms. Inger Coble. The evening was filled with good food and drinks, and stories recounting great memories involving two wonderful people, Judy and Gabor Somorjai.

This Special Issue of Topics in Catalysis is assembled to honor his life-long education and contribution in surface science, catalysis and interfacial chemistry. It contains 39 contributions covering a wide range of these topics.

This issue starts out with a collection of papers focusing on theoretical and experimental aspects of surface science. Roel Prins discusses the historical accuracy of the Eley–Rideal reaction, suggesting some reactions currently defined as Eley–Rideal reactions should actually be referred to as the Langmuir–Rideal reaction. The real Eley–Rideal reaction is a reaction between a chemisorbed molecule and a physisorbed molecule. Neurock and Tysöe demonstrate adsorbate coverage(s) control vinyl acetate monomer formation rate and selectivity on Pd(111), and these coverage effects have the same influence as ensemble and electronic effects on Au/Pd(111) alloys. Mavrikakis and co-workers utilized DFT methods to calculate binding structures and energies of atomic and molecular adsorbates, and the thermochemistry for the decomposition of a number of small molecules on Cu(111). Rupprechter and co-workers employ polarization-dependent sum frequency generation (SFG) vibrational spectroscopy to study CO adsorption on Pt(111) and Pd(111) surfaces with primary objective to determine the tilt angle of adsorbed CO on these surfaces. DFT calculations by McEwen and co-workers examined the effect of external electric fields on the lateral interactions between adsorbed molecules on Fe surfaces. Asscher studied collision induced desorption of trimethylamine from Ru(0001) and demonstrated molecular desorption is a dominant pathway due to efficient energy dissipation with the adsorbate. Pancotti, Nascente and co-workers used XPS and X-ray photodiffraction to study the oxidation of Nb(100) by oxygen;

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it was determined that metallic Nb was covered by NbO islands. The surface structure and reactivity of V-doped TiO₂(110) was characterized by a suite of surface science techniques, as well as the performance of varying the V content in TiO₂ single crystal for the partial oxidation of methanol by Song, Kühlenbeck and Freund.

A number of publications focus on the synthesis, characterization and reactivity studies of supported heterogeneous catalysis. Harold Kung created inverse catalysts by decorating Au nanoparticles with mononuclear Ti complexes which demonstrated enhanced propane oxidation activity and selectivity to acetone compared to bare Au nanoparticles. Weng and Zaera demonstrate a number of synthetic strategies for the preparation of chiral-dendrimer encapsulated Pt nanoparticles which showed poor performance for the hydrogenation of keto-esters probably due to reduced chain flexibility and mass transport limitation. Park and co-workers examined the influence of isotope effects on hot electron generation during the formation of water from H₂ (or D₂) and O₂. Gross and co-workers review the latest developments in the field of high spatial resolution spectroscopy measurements of catalytic reactions on the surface of solid catalysts and discuss challenges and opportunities for high spatial resolution spectroscopy to impact catalysis science. Corma and co-workers conducted a combined experimental and theoretical electron parametric resonance spectroscopy study of Cu²⁺ ions in zeolites in order to identify the active Cu²⁺ species in the selective catalytic reduction of nitric oxide. Hutchings et al. prepared Ru/C catalysts by sol immobilization and examined these catalysts for the hydrogenation of levulinic acid to γ -valerolactone. Kuhn and co-workers utilized core-shell materials as catalyst for the size-selective reforming of methane and toluene at low temperatures by controlling the transport of molecules through a zeolite shell layer. In a review of preparation techniques for the synthesis of size-controlled metal clusters, Zhang et al. focus on the variation of metal support interactions (MSI) on supports with differing reducibility and conductivity. Photocatalytic transformation of methane–water mixtures over Rh and Au catalysts supported on protonated titanate nanotubes was examined by Konya et al; the plasmonic property of Au determined the reaction pathway leading to more oxidized carbon products than were observed on Rh. Iwasawa and co-workers utilized X-ray absorption spectroscopy and diffraction to examine the structural transformation of Pt nanoparticles in Pt/C during transient voltage operation. The relationship between the structural kinetics with electrocatalytic performance are key issues to consider for the development of next generation fuel cells.

A selection of papers focused on the influence of alloying on the behavior of supported metal nanoparticles for catalytic applications. Utilizing Pt–Fe nanoparticles in mesoporous silica, Huang and co-workers distinguished

between the role of iron and surface modifying ligands during the selective hydrogenation of cinnamaldehyde to cinnamyl alcohol. Zhang and co-workers synthesized Au@Pd nanorods with controllable aspect ratio in a single pot method for application in the electrocatalytic oxidation of ethanol. Wang and co-workers analyzed the solid-state chemistry and surface structures of synthesized cobalt mono-phosphosulfide materials and evaluated their electrocatalytic properties for the hydrogen evolution reaction. In a contribution from Song et al., a general synthetic protocol was developed to generate metal–CdSe double shell hollow nanocubes utilizing three diverse solid-state reactions. The Pt–CdSe double shell hollow nanocubes catalyzed hydrogen evolution under photoirradiation. Beaumont and colleagues examined the impact of particle size on the Co-catalyzed oxygen evolution reaction. In a review on the catalytic oxidation of carbon monoxide, An and co-workers summarize the impact of nanochemistry, in-situ characterization techniques and metal–support interactions on our understanding of this important reaction.

Three contributed manuscripts focus on an important reaction—Fischer–Tropsch (FT) synthesis. Malaet and co-workers review the impact of Co-based bimetallic catalysts for FT synthesis and assess the influence of electronic and structural effects by single particle characterization and in-situ X-ray absorption spectroscopy. Kruse and co-workers utilize atom probe tomography to characterize the composition and structure of CoCuMn and CoMnK catalysts for oxygenate formation during FT synthesis. In a mechanistic study of FT synthesis over Co, Holmen and co-workers propose CO activation is facilitated by hydrogen transfer from water and chain growth probability depends solely on the surface coverage of CH* monomers.

This issue also contains a number of fundamental studies of electrochemical reactions. Gracias and co-workers used SFG to investigate the electrooxidation of ethanol and ethylene glycol and found the cause for slower conversion of ethanol over ethylene glycol. Seo and his team focused on the photoelectrochemical splitting of water into H₂ and O₂ on different structures of WO₃ and reviewed the structural factors of WO₃ influencing water splitting efficiency. Joo and co-workers reviewed recent synthetic strategies employed in the preparation of metal and nitrogen co-doped carbon catalysts to enhance the catalytic activity of these materials for the oxygen reduction reaction.

A series of papers on biological interfaces are covered in this issue. Castner and his colleagues provide a review of the principles, strengths and limitations of several nonlinear optical methods for characterizing biological systems. Chen Wang and colleagues reviewed recent progresses in the characterization of the interface between protein/peptide and surface using scanning tunneling microscopy to obtain physical insights into protein–interface interactions at the

level of single amino acids. Peilin Chen and his team developed stem cell culture substrates using polymeric pillars and showed that the chemical environment of cell culture substrates can be regulated by modifying the surface chemistry of pillars with peptides. Zhan Chen and colleagues studied the interactions between silver nanoparticles and model cell membranes and found that silver nanoparticles could induce lipid flip-flop.

The special issue also covers fundamental studies in environmental surface sciences. Lovering and Chou reviewed nonlinear optical spectroscopy studies on the dynamic growth of ice at solid surfaces and discussed how ice formation is promoted by the presence of a solid surface. Leygraf and colleagues employed DFT calculations to elucidate chemical reactions involved in atmospheric corrosion of aluminum alloy as a function of relative humidity. Materer and co-workers studied reactions of molybdenum hydrogen bronze with hydrogen peroxide and an organic peroxide using colorimetry and DFT calculations and showed how

the reaction rate is influenced by electron density at the surface. Cabrera and his team deposited epitaxial thin films of copper delafossite oxides for use as electrochemical water photolysis catalysts, and studied adsorption of CO₂ and H₂O on these surfaces. Halide perovskites are gaining attention as a potential material for solar cells, but it faces a poor environmental stability. Bardi and colleagues investigated the stability of different bromine-based perovskites in humid air and monitored the structural and chemical evolution of perovskites.

The breadth and depth of the papers in this Special Issue reflect the scientific impacts Professor Somorjai has made through the many years of educating students and postdocs at the University of California, Berkeley and interacting with peers throughout the world. His life-long accomplishment does not stop here with his retirement; it will have long lasting impacts in surface science through the work to be done by the disciples and friends of Professor Somorjai.