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Michael D. Detwiler, Cory A. Milligan, Dmitry Y. Zemlyanov, W. Nicholas Delgass, Fabio H. Ribeiro

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Kinetics of Gas Phase Formic Acid Decomposition on Platinum Single Crystal and Polycrystalline Surfaces

Michael D. Detwiler,[†] Cory A. Milligan, [†] Dmitry Y. Zemlyanov, [‡] W. Nicholas Delgass,[†] and Fabio H. Ribeiro*,[†]

†School of Chemical Engineering, Purdue University, West Lafayette, Indiana, 47907, United States

‡Birck Nanotechnology Center, Purdue University, West Lafayette, Indiana, 47907, United States

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ABSTRACT

Formic acid dehydrogenation turnover rates (TORs) were measured on Pt(111), Pt(100), and polycrystalline Pt foil surfaces at a total pressure of 800 Torr between 413 – 513 K in a batch reactor connected to an ultra-high vacuum (UHV) system. The TORs, apparent activation energies, and reaction orders are not sensitive to the structure of the Pt surface, within the precision of the measurements. CO introduced into the batch reactor depressed the formic acid dehydrogenation TOR and increased the reaction's apparent activation energies on Pt(111) and Pt(100), consistent with behavior predicted by the Temkin equation. Two reaction mechanisms were explored which explain the formic acid decomposition mechanism on Pt, both of which include dissociative adsorption of formic acid, rate limiting formate decomposition, and quasi-equilibrated hydrogen recombination and CO adsorption. No evidence was found that catalytic supports used in previous studies altered the reaction kinetics or mechanism.