Selectivity Control in Acid-Base Catalysis for Valorization of Biomass Derivatives

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Abstract: High-performance solid acid-base catalysts are among the keys to the transformation of biomass feedstock into fuels, chemicals and materials because they determine not only the rates but also selectivity of such transformation by 'steering' reactions including but not limited to hydrolysis, dehydration, cracking, condensation, esterification, etherification and transfer hydrogenation. This presentation aims to address the functions of solid acid-base catalysts for selective transformations of several of biomass derivatives (biomass-based platform molecules), including glycerol, lactic acid and ethyl lactates, levulinic acid and methyl levulinate, with a focus on showing how the product selectivity would vary with the nature and number of the acidic and basic sites on the surfaces of typical solid acid-base catalysts. The catalytic reactions involved in the discussion will include: 1) glycerol dehydration for acrolein production, 2) dehydration of lactic acid or ethyl lactate for acrylic acid production, 3) transfer hydrogenation of levulinic acid or methyl levulinate with 2-propanol for γ-valerolactone production. Catalyst surface acid-base properties and specific to the catalysis for selectivity control in these three reactions will be highlighted.

Keywords: Acid-base catalysis, Biomass valorization, Selectivity control, Platform molecules