The critical role of counter anions of potassium salts in the K-ZSM-5 for the dehydration of lactic acid to acrylic acid

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Due to concerns about global warming and increasing carbon emission, utilization of renewable resources such as biomass as a carbon source is receiving much attention in petrochemical industry. Especially, acrylic acid(AA) is a versatile monomer for the synthesis of various polymers and advanced materials such as polyacrylic acid, but currently produced by the oxidation of petroleum-derived propylene. The dehydration of biomass-derived lactic acid(LA) to AA is a promising alternative to petroleum-based route, once we can achieve the high AA selectivity. Due to the highly favorable competing decarbonylation reaction for acetaldehyde(AD) formation as well as the coking of LA, the selectivity control in LA conversion is highly challenging. Prior works reported the high selectivity of alkali-exchanged zeolites with various pore structures such as K-ZSM-5, NaY, Cs-Beta zeolite up to ~60% due to its well-balanced Lewis acidity and basicity. In this work, we report on the critical role of counter anions of potassium salts in promoting the AA selectivity as high as ~80% and elucidate how the LA dehydration mechanism is affected by the different zeolites through in-situ FT-IR spectroscopy.