Insight into the green path to dimethyl succinate by direct esterification of sodium succinate using CO2 and CH3OH

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Abstract

The fermentation for the production of succinic acid (SA) outperforms other methods by low energy consumption and environmental benignity, with the resulted products mainly as disodium succinate (DSA). By the direct esterification of DSA using CO2 and CH3OH, it is expected to avoid the use of inorganic acids in downstream industrial esterification of bio-based DSA. By high-resolution mass spectrometry analysis and theoretical calculation,this study establishes that the direct esterification of DSA consists of three steps by first forming 3-carboxypropanoate,then monomethyl succinate (MMS),and finally DMS. The reaction kinetics of DSA direct esterification is also investigated by experiment and simulation with MATLAB, and the reaction kinetics equation along with reaction rate constant are obtained. The activation energy for the generation of MMS from DSA is 37.15 kJ/mol,and the one for the generation of DMS from MMS is 85.80 kJ/mol,indicating the latter one is the rate-determining step for the direct esterification of DSA.

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