Anderson-type polyoxometalates support on orange peel activated carbon for efficient ethyl levulinate production

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Ethyl levulinate (EL) is hailed as the ideal lipid chemical derived from biomass due to its low toxicity, high lubricity, and low temperature fluidity, making it suitable as a fuel additive for gasoline, diesel, etc [1-3].

This study highlights a series of Anderson-type polyoxometalates (POMs), namely ($Na_3H_6FeMo_6O_{24}$ ($FeMo_6$), $(NH_4)_4H_6ZnMo_6O_{24}$ ($ZnMo_6$), $(NH_4)_3H_6CoMo_6O_{24}$ ($CoMo_6$), and $(NH_4)_4H_6CuMo_6O_{24}$ ($CuMo_6$)-orange peel activated carbon (OPAC) catalysts, which are synthesized for the production of EL from furfural alcohol (FAL). Impressively, 20% $ZnMo_6$-OPAC possesses suitable total acidic strength (3.3 $cm^3\ g^{-1}$) with highest Brønsted-Lewis ratio (1.3), enhanced reducibility capacity, as well as a moderate BET surface area (500.5 $m^2\ g^{-1}$) with appropriate pore volume and size (3.5 nm) to afford excellent performance. The active species responsible for the alcoholysis of FAL to EL was identified as e^- through scavenger experiments. From DFT calculation, FAL is more likely to be adsorbed on $ZnMo_6$-OPAC (-0.533 eV) than OPAC surface (-0.144 eV), as well as the robust electron transferring capacity of ZnMo6-OPAC (-0.3259 *e*) vs. OPAC (-0.0009 *e*) after Anderson-type POMs loading. Important intermediates such as ethoxymethylfuran (EMF) and 5-ethoxy-5-(ethyl-oxidaneylidene) pentan-2-one were found through GC-MS. Catalyst recycling showed good performance up to the fifth cycle (70% FAL conversion and 47% EL yield), showcasing its potential for practical application [4].

References

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