Catalysis Letters
https://doi.org/10.1007/s10562-023-04360-9

Direct Valorization of Cellulose and Glucose to Glycolic Acid through Green Catalytic Process

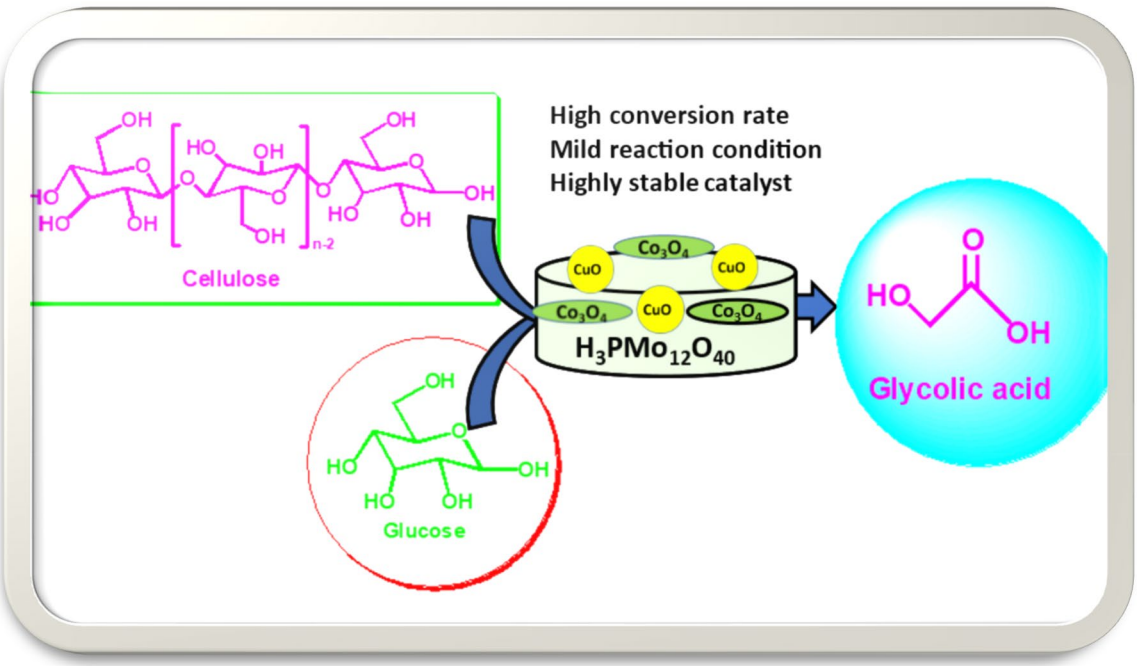
Venkata Rao Madduluri[1,2] · Mei Ying Lim[1] · Anisah Sajidah Saud[1] · Gaanty Pragas Maniam[1] · Mohd Hasbi Ab Rahim[1,2]

Received: 27 February 2023 / Accepted: 28 April 2023

Abstract

The current work reports the catalytic conversion of α-cellulose to glycolic acid using molecular oxygen as an oxidant. A series of copper and cobalt molybdophosphoric acid catalysts (Cu-$H_3PMo_{12}O_{40}$ and Co-$H_3PMo_{12}O_{40}$) were synthesized via impregnation and ion-exchange techniques. Then the synthesized catalysts are thoroughly tested for effective conversion of α-cellulose and glucose into glycolic acid and value-added chemicals. The physicochemical characterization of as prepared catalysts was carried out using X-ray diffraction (XRD) and a scanning electron microscope-energy dispersive spectrometer (SEM–EDS). Fourier-transform infrared spectroscopy (FT-IR), N_2-Physisorption and the Hammett test, on the other hand, were used to determine the quantitative relationship between catalyst structure and catalyst activity. Under mild reaction conditions, glycolic acid was discovered to be the primary product with 99.8% selectivity and 99% yield over a Cu-impregnated $H_3PMo_{12}O_{40}$ catalyst. It was also revealed that the catalytic activity was directly related to the catalyst surface area, degree of crystallization, and surface acidic strength. Moreover, synergic interactions of active metals with support materials, Bronsted and Lewis acid properties possessed by catalysts are major determinants of better catalytic activity.

Graphic Abstract



Extended author information available on the last page of the article

Published online: 18 May 2023