

Highly selective transformation of poly[(R)-3-hydroxybutyric acid] into trans-crotonic acid by catalytic thermal degradation.

ABSTRACT

Highly selective transformation of poly[(R)-3-hydroxybutyric acid] (PHB) into trans-crotonic acid was achieved by thermal degradation using Mg compounds: MgO and Mg(OH)₂ as catalysts. Through catalytic action, not only the temperature and E_a value of degradation were lowered by 40–50 °C and 11–14 kJ mol⁻¹, respectively, but also significant changes in the selectivity of pyrolyzates were observed. Notably, Mg(OH)₂ showed nearly complete selectivity (~100%) to trans-crotonic acid. Kinetic analysis of TG profiles revealed that the catalytic thermal degradation of PHB was initiated by some random degradation reactions, followed by the unzipping β -elimination from crotonate chain-ends as a main process. It was suggested that the Mg catalysts promote the totality of the β -elimination reactions by acting throughout the beginning and main processes, resulting in a lowering in the degradation temperature and the completely selective transformation of PHB.

Keyword: Polyhydroxy butyrate; Catalytic depolymerization; Crotonic acid; Unzipping β -elimination; Kinetic analysis.