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# Kinetics and mechanisms of the thermal decomposition of copper(II) hydroxide under different water vapour pressures

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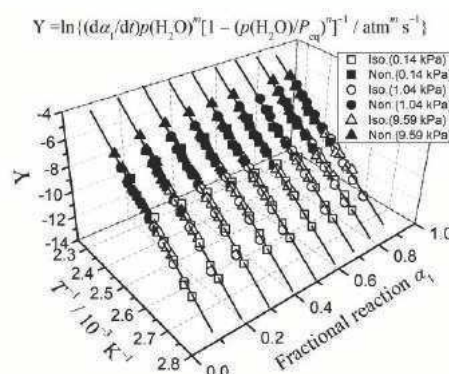
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Thermal decomposition of  $\text{Cu}(\text{OH})_2$  exhibits specific physico-geometric kinetic characteristics involving the significant induction period (IP) and subsequent sigmoidal mass-loss behaviour under isothermal conditions and the two-step mass-loss process with a long lasting reaction tail under linearly increasing temperature conditions. In addition, the rate behaviours of IP and mass-loss process are largely influenced by the environmental water vapour pressure,  $p(\text{H}_2\text{O})$ . The IP at a constant temperature is prolonged with increasing  $p(\text{H}_2\text{O})$ . The mass-loss curves shift systematically to higher temperatures with increasing  $p(\text{H}_2\text{O})$ . Therefore, the kinetic approach to this complex reaction requires the detailed considerations of the mechanistic features and the impact of  $p(\text{H}_2\text{O})$ .

For the universal kinetic approach to each kinetic process under different  $p(\text{H}_2\text{O})$ , an accommodation function with respect to  $p(\text{H}_2\text{O})$  was derived:

$$a(p(\text{H}_2\text{O}), P_{\text{eq}}(T)) = \frac{1}{p(\text{H}_2\text{O})^m} \left[ 1 - \left( \frac{p(\text{H}_2\text{O})}{P_{\text{eq}}(T)} \right)^n \right]$$

The accommodation function  $a(p(\text{H}_2\text{O}), P_{\text{eq}}(T))$  can be introduced into different kinetic equations for describing the IP and mass-loss process. The IP at different temperatures and under different  $p(\text{H}_2\text{O})$  analysed kinetically by a single Arrhenius-type plot, providing a statistically significant linearity and the activation energy  $E_{a,\text{IP}} = 243 \pm 13 \text{ kJ mol}^{-1}$ . Similarly,  $a(p(\text{H}_2\text{O}), P_{\text{eq}}(T))$  is introduced into the isoconversional kinetic equation for analyzing universally the mass-loss process under different temperature conditions and  $p(\text{H}_2\text{O})$ . The isoconversional plots applied to the major mass-loss step of the thermal decomposition of  $\text{Cu}(\text{OH})_2$  represent straight lines and the average  $E_{a,1} = 148 \pm 1 \text{ kJ mol}^{-1}$  (Fig. 1). Furthermore, the overall thermal decomposition of  $\text{Cu}(\text{OH})_2$  under isothermal conditions can be described by the IP–surface reaction (SR)–phase boundary controlled reaction (PBR) model [1]. The rate constants of each component reaction step determined under different  $p(\text{H}_2\text{O})$  are subjected to the Arrhenius plot by considering  $a(p(\text{H}_2\text{O}), P_{\text{eq}}(T))$ .



**Fig. 1.** The results of the universal Friedman plot applied to the first mass-loss step of thermal decomposition of  $\text{Cu}(\text{OH})_2$  under different  $p(\text{H}_2\text{O})$ .

## REFERENCE

[1] H. Ogasawara, N. Koga, J. Phys. Chem. A., 118 (2014) 2401