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Catalytic effects of V₂O₅ on oxidative pyrolysis of spent cation exchange resin

Key words: Waste disposal, Cation exchange resin, V₂O₅, Catalysis, Oxidative pyrolysis

Catalytic effect of V_2O_5

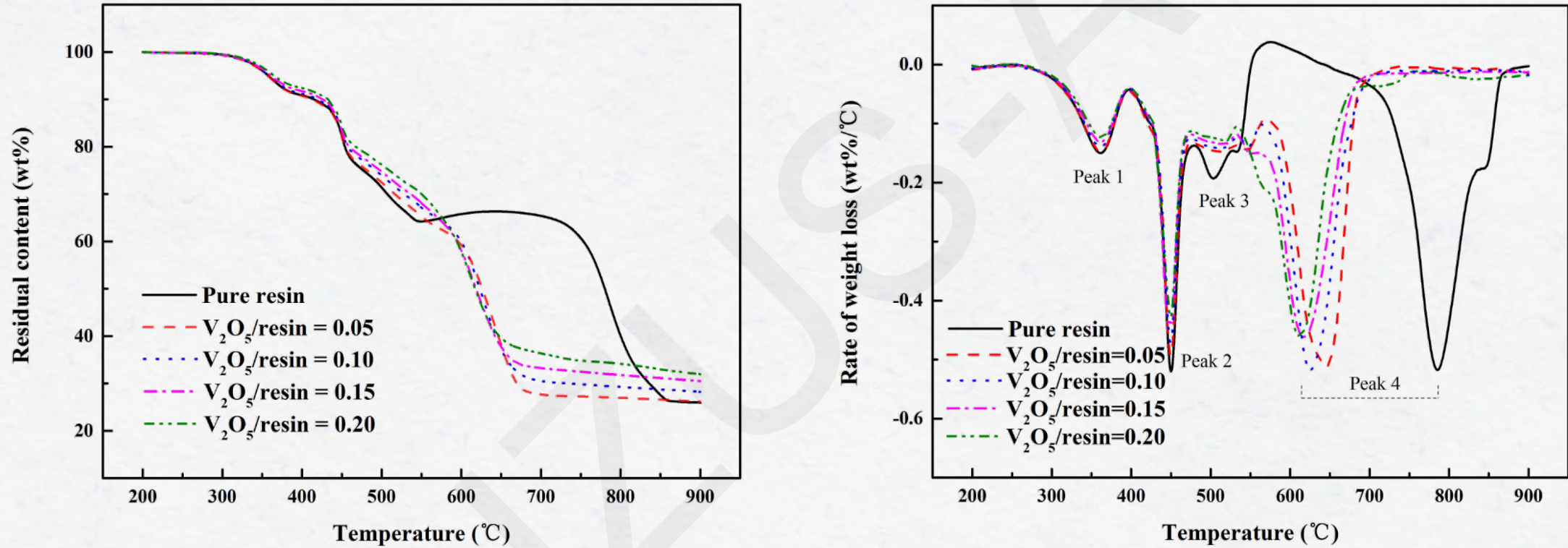


Fig. 1. Thermogravimetric curves of the resin with different amounts of V_2O_5 .

➤ V_2O_5 can promote the pyrolysis of spent cation exchange resin.

Comparison of different catalysts

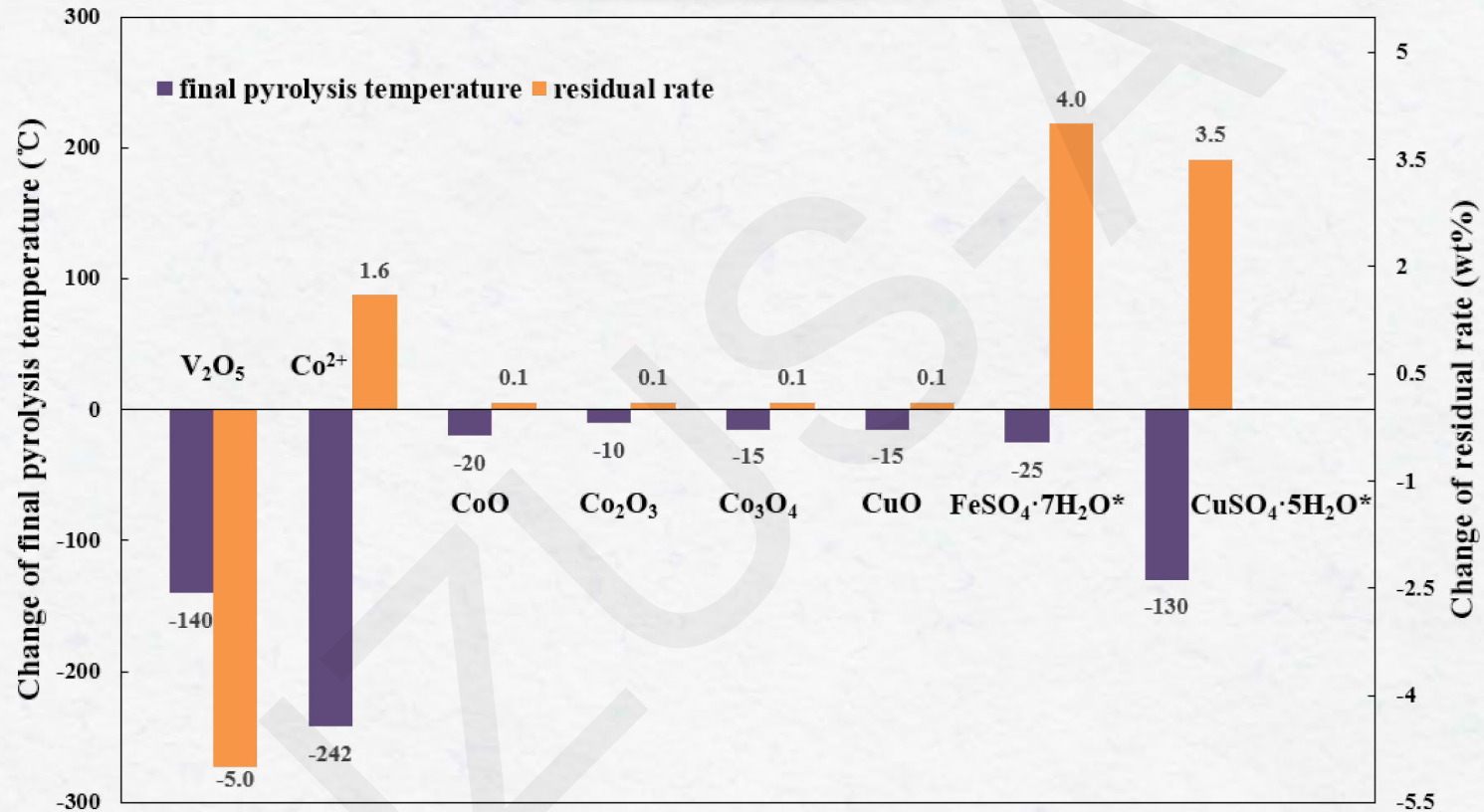
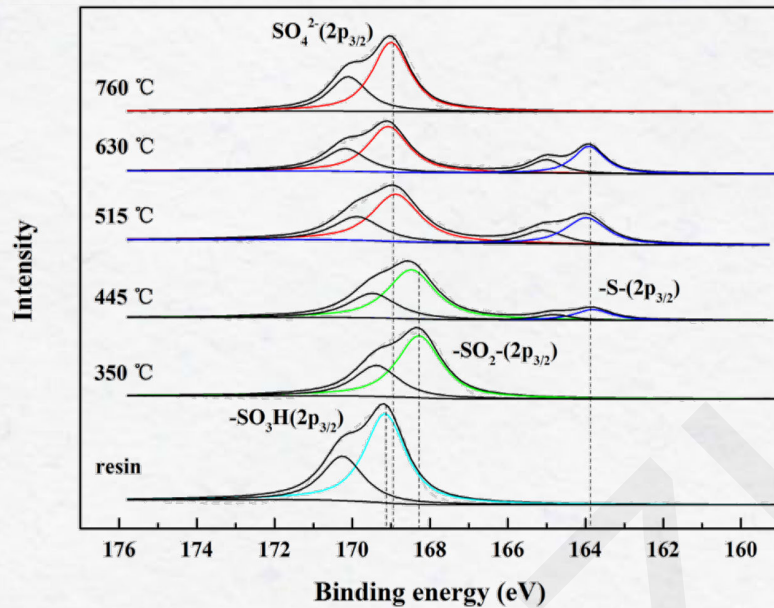


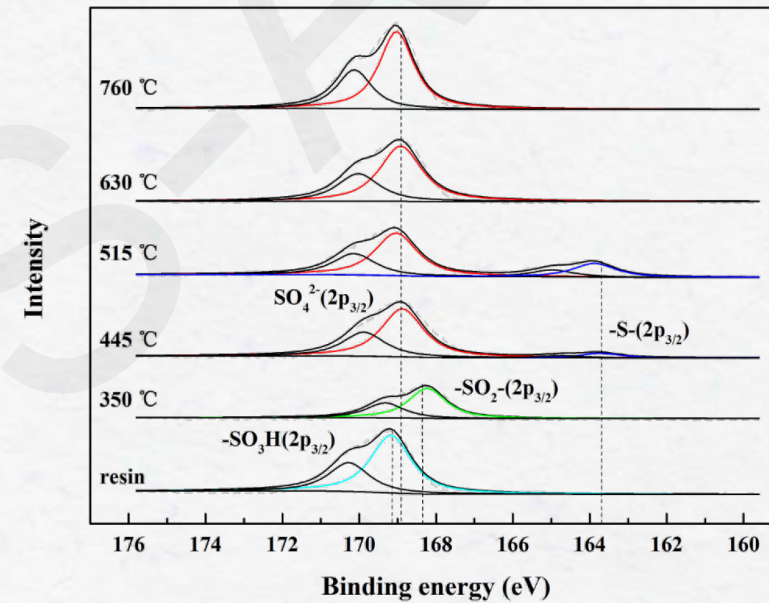
Fig. 2. Performance comparison of different catalysts for oxidative pyrolysis of resin.

- V₂O₅ performs better than other catalysts: decreased the temperature and residual rate simultaneously.

Chemical valence



(a) Pure resin



(b) V_2O_5 mixed resin

Fig. 3. XPS spectrums of pyrolysis residue at different temperatures.

- V_2O_5 can promote the formation of SO_4^{2-} at a lower temperature (445 °C) and decrease the decomposition temperature of $-\text{S}-$.

Properties of different catalysts

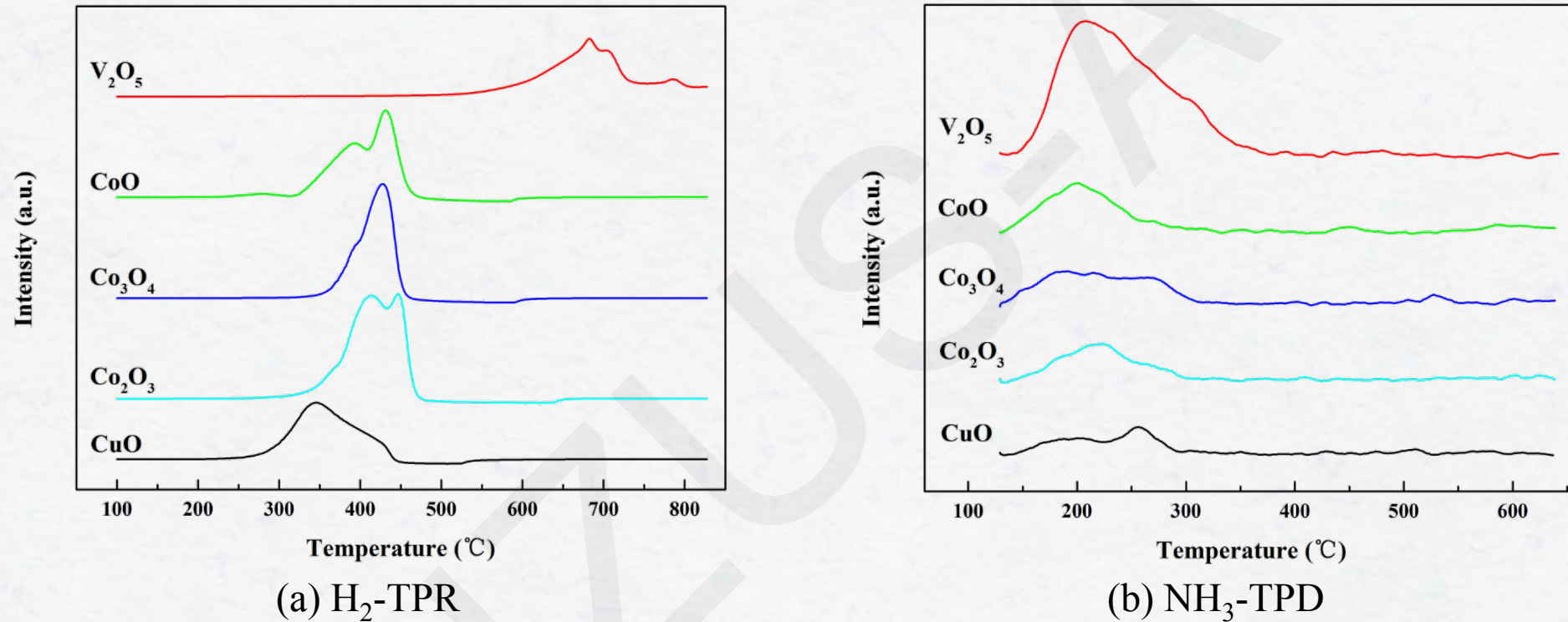


Fig. 4. Oxidation-reduction performance and acid sites of different catalysts.

- Compared to other catalysts, V₂O₅ has more acid sites while having oxidizing ability.

Catalytic mechanism of V_2O_5

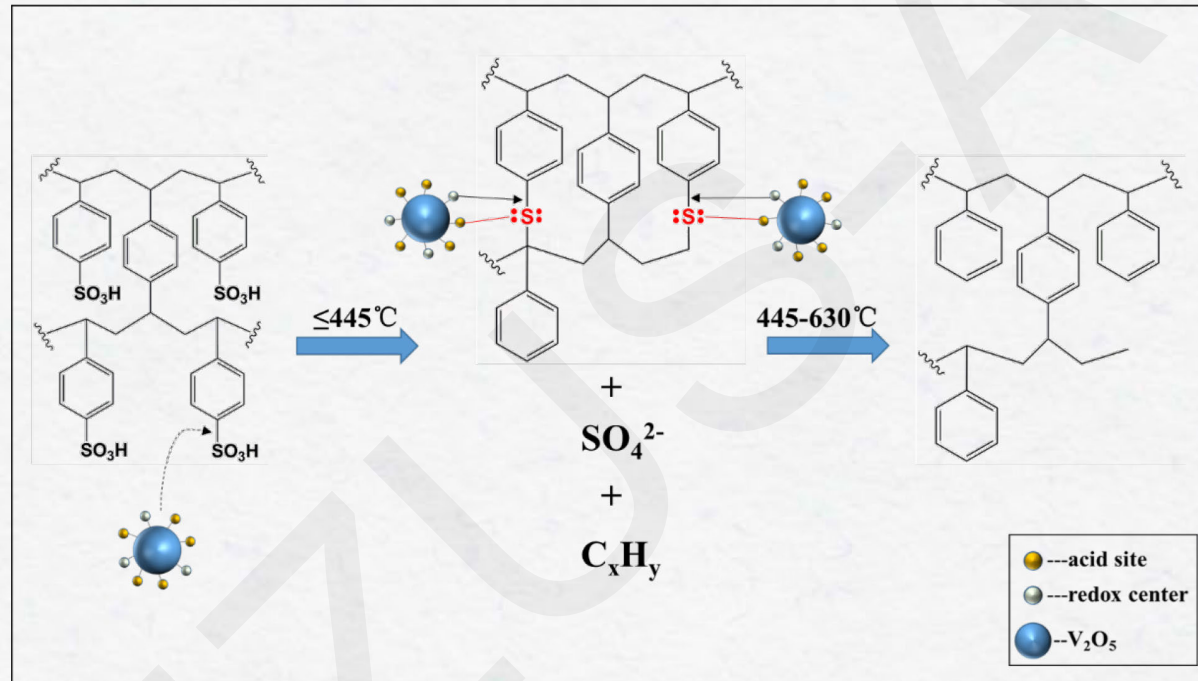


Fig. 5. Catalytic mechanism of V_2O_5 on the pyrolysis of resin.

- Under the effect of acid sites, V_2O_5 can be in close contact with the sulfur bond through chemisorption to further exert the catalytic effect of oxidation-reduction centers.

Conclusions

- **V_2O_5 achieves the decrease of final pyrolysis temperature and residual rate simultaneously even added by physical blending on the pyrolysis of waste resin.**
- **Under the action of V_2O_5 , low-temperature (445°C) removal of partial sulfonic acid groups occurs, and it promotes the pyrolysis of resin copolymer matrix.**
- **The catalytic activity of V_2O_5 is determined by both effects of acid sites and oxidation-reduction centers. The catalytic effect of oxidation-reduction centers is achieved by close contact with the sulfur bond through chemisorption under the effect of acid sites.**