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## The Role of Brønsted and Lewis Acid Sites of Vanadyl Pyrophosphate Measured by Dimethylpyridine-temperature Programmed Desorption in the Selective Oxidation of Butane

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Acidic properties of three types of  $(VO)_2P_2O_7$  catalysts were investigated by temperature programmed desorption (TPD) using 3, 5- and 2, 6-dimethylpyridine as probes, and the selective oxidation of butane to maleic anhydride (MA) was performed. VPO-org was prepared in organic solvent, VPO-redu was obtained by reduction of  $VOPO_4 \cdot 2H_2O$ , and VPO-aq was prepared in aqueous medium. 3, 5-Dimethylpyridine (3, 5-DMP) is adsorbed on both Brønsted and Lewis acid sites, whereas 2, 6-dimethylpyridine (2, 6-DMP) is selectively adsorbed on Brønsted acid sites due to the steric hindrance of the two methyl groups, so the amounts and strengths of the Brønsted and Lewis acid sites could be determined separately. The  $(VO)_2P_2O_7$  catalysts had four types of acid sites: weak and strong Brønsted acid sites, and weak and strong Lewis acid sites. The acidic properties were greatly dependent on the preparation methods as follows: VPO-org had a larger amount of the strong Brønsted acid sites and these acid sites were relatively weak. VPO-redu had a larger amount of the strong Lewis acid sites and VPO-aq had fewer acid sites. The selectivity to MA at low conversion increased with the amount of strong Lewis acid sites, indicating that the strong Lewis acid sites are important for MA formation. The strong Brønsted acid sites may promote the consecutive oxidation of MA.

**Keywords:** [Vanadyl pyrophosphate catalyst](#), [Acidic property](#), [Dimethylpyridine](#), [Temperature programmed desorption](#), [Butane oxidation](#), [Maleic anhydride](#)

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