

### Experiment on Hydrogenation Reaction Conditions

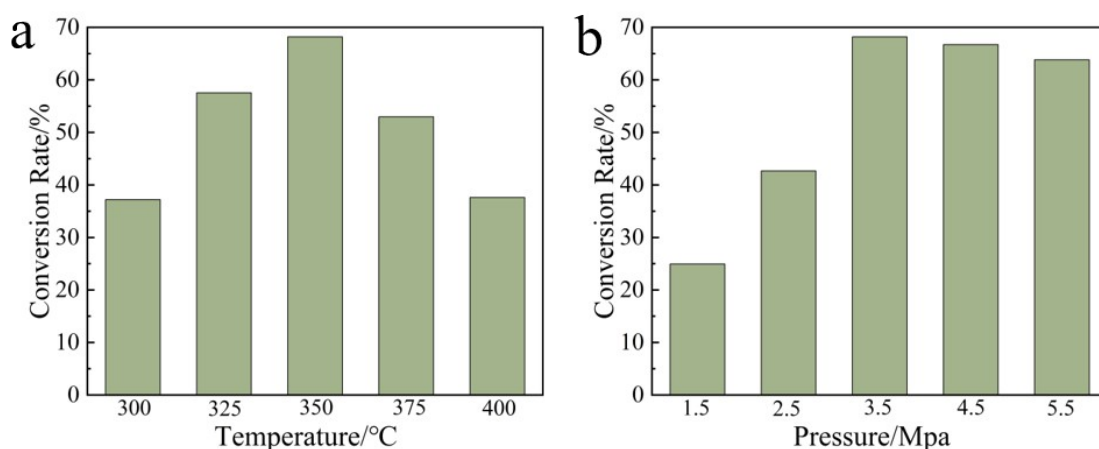


Fig.S1 Results of naphthalene hydrogenation in experiments

To investigate the influence of reaction parameters on the hydrogenation of naphthalene, this study employed single-factor experiments using unmodified MoS<sub>2</sub> as the catalyst, and systematically examined the effects of reaction temperature (300-400 °C) and reaction pressure (1.5-5.5 MPa) on the hydrogenation of naphthalene. The experimental results indicate that reaction conditions have a significant impact on the performance of this catalytic system. Within the investigated range of reaction conditions, the highest yield of the target product, tetralin, was observed at a reaction temperature of 350 °C and a reaction pressure of 3.5 MPa. Consequently, in subsequent studies, we have established these optimal parameters (350 °C, 3.5 MPa) as the conditions for the naphthalene hydrogenation reaction.

## Catalyst Recovery Experiment

Representative samples exhibiting higher tetralin yields—0.015M KCl, 0.01M MgCl<sub>2</sub>, and 0.01M AlCl<sub>3</sub>—underwent systematic recoverability studies. (Each sample was recovered three times, with reagent and solvent quantities scaled down proportionally to the catalyst recovery rate.)

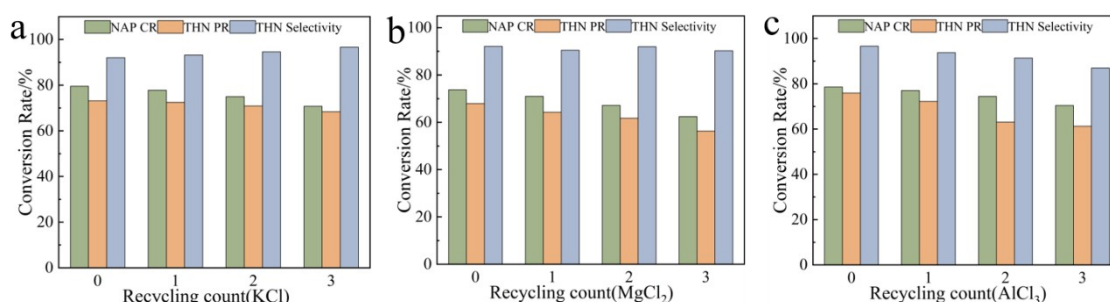


Fig.S2 Results of naphthalene hydrogenation in catalyst recovery experiments

Judging from the cyclic experimental data, the overall stability of the catalyst's activity was mediocre; as the number of reaction cycles increased, both the naphthalene conversion rate and the yield of the target product showed a marked downward trend. Specifically, following modification with 0.015M KCl, after three cycles, the naphthalene conversion rate decreased from 79.51% to 70.77%, and the tetralin yield decreased from 73.15% to 68.37%; however, the selectivity increased slightly, indicating that the deactivation of active sites has, to some extent, suppressed side reactions. Under 0.01M MgCl<sub>2</sub> conditions, the naphthalene conversion, tetralin yield and selectivity all continued to decline, falling from 73.76%, 67.93% and 92.09% to 62.41%, 56.29% and 90.23% respectively, demonstrating a comprehensive decline in catalyst performance. In the 0.01M AlCl<sub>3</sub> system, the naphthalene conversion rate decreased from 78.59% to 70.42%, the tetralin yield fell significantly from 75.92% to 61.24%, and the selectivity also dropped from 96.60% to 86.96%, representing the most pronounced decline, indicating a relatively rapid deactivation rate of the catalyst under these conditions. In summary, all systems exhibited varying degrees of activity decline during cyclic use. Among them, the AlCl<sub>3</sub> system demonstrated the poorest stability, whilst the KCl system, although exhibiting a decline in activity, maintained relatively good selectivity. This may be attributed to high temperatures altering the crystal phase, leading to a reduction in the content of 1T-MoS<sub>2</sub>.