

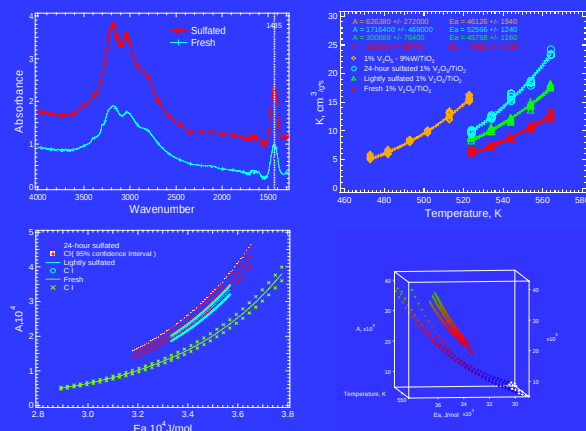
Sulfate, K, Na, and Ca Effects on Vanadia Catalyst Activity

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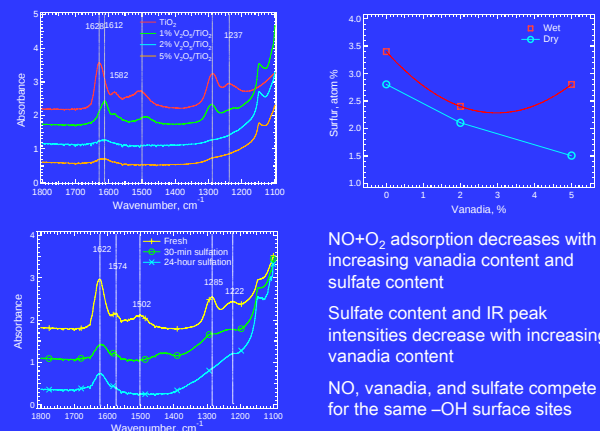
Objectives

- Determine sulfate species impacts on SCR performance.
- Determine impacts of alkali and alkaline earth compounds on SCR performance.
- Determine mechanisms and rates of tungsten impacts on SCR catalysts.

Sulfate impact on vanadia catalyst behavior

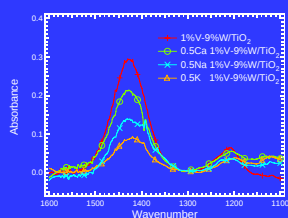


Surface site identification



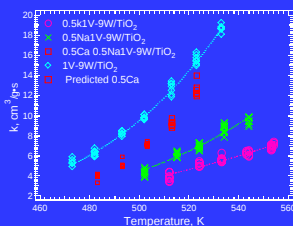
NO+O₂ adsorption decreases with increasing vanadia content and sulfate content
Sulfate content and IR peak intensities decrease with increasing vanadia content
NO, vanadia, and sulfate compete for the same -OH surface sites

Poisons impact on vanadia catalysts



NH₃ adsorption intensities on Brønsted acid sites decrease proportional to metal's basicity

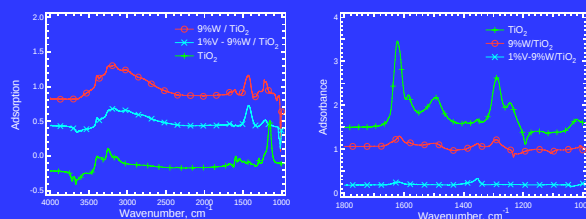
Catalyst poisoning increases with species in the order Ca < Na, < K, which is proportional to basicity. All alkali and alkaline earth metals are significant poisons.



Tungsten impact on vanadia catalyst

1000 ppm NH₃ adsorption at 50 °C

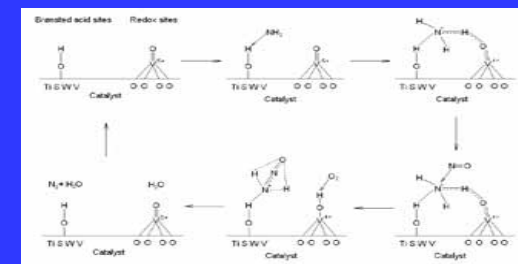
1970 ppm NO + O₂ adsorption at room temperature



Tungsten increases Brønsted acid site density and decreases Lewis acid site density on TiO₂

Tungsten suppresses NO adsorption by occupying its interaction site, -OH.

Proposed Mechanism & Rate Constant



$$k = \exp \left(\frac{2.5 - 1.16 \frac{K}{F} - 0.74 \frac{Na}{F} - 0.3 \frac{Ca}{F} + 0.17 \frac{S}{S_0} + 0.34 \frac{K}{F S_0}}{+ 0.55 \frac{Na}{F S_0} + 0.17 \left(\frac{1}{F} - \frac{1}{I_0} \right) - 0.12 \frac{S}{S_0} \left(\frac{1}{F} - \frac{1}{I_0} \right)} \right)$$