

## VANADIUM OXIDE EXTENDED FRAMEWORKS: STRUCTURAL CHEMISTRY AND APPLICATIONS

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Much interest in vanadium oxides and their intercalates is due to their application in oxidative catalysis and often unique magnetic [1] and electrochemical [2] properties. The vanadium oxide frameworks have rich crystal-chemistry [3] and intercalation chemistry due to the variety of vanadium coordination polyhedra and wide range of oxidation states. The latter defines red-ox properties, which readily allow the insertion or removal of ions such as lithium (Fig. 1).

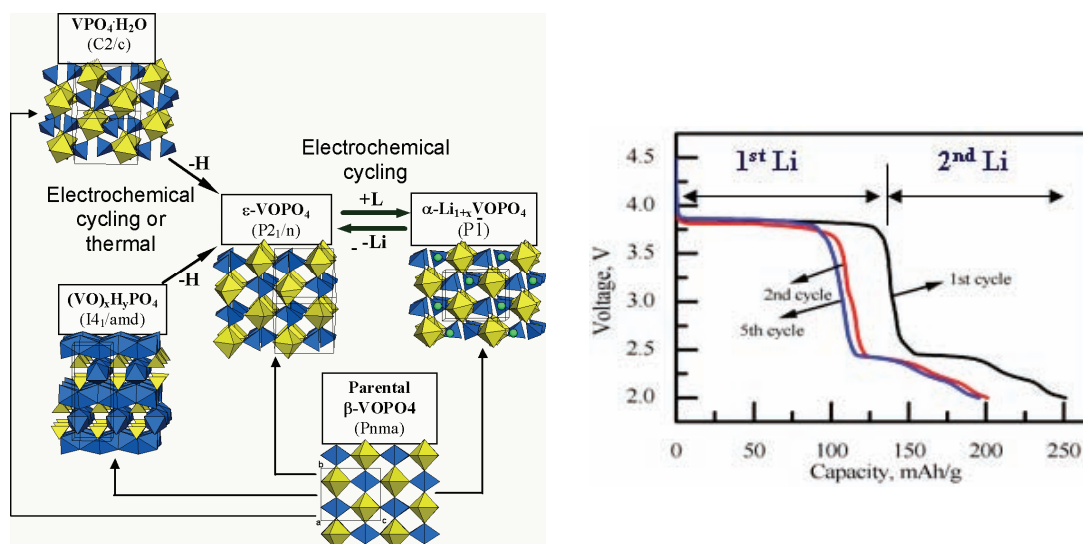


Fig. 1. Structural relationship of vanadium phosphates (left) and electrochemical cycling (right)

The formation of the vanadium oxide frameworks is dictated to a great extent by the intercalating/templating species usually such as ammonium, tetramethyl ammonium (*tma*), lithium and other metals or their complexes. The size, shape and other properties (e.g. charge) of the intercalated molecules and ions play key roles in the framework formation. In addition, mismatch in the size of the intercalated species and periodicity of the framework often yields modulation of the framework or disorder of the intercalated species. Thus, disordered  $(NH_4)_2V_3O_8$  structure at room temperature turns into 2D incommensurate modulated structure at lower temperatures; while *tma*V<sub>4</sub>O<sub>10</sub> structure that is 1D incommensurate modulated at RT becomes commensurate when cooled down.

### References

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- [2] Song Y., Zavalij P.Y., Whittingham M.S. *J. Electrochem. Soc.*, **152**, A762, 2005.
- [3] Zavalij P.Y., Whittingham M.S. *Acta Cryst.*, **B55**, 627, 1999.