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# Supporting Information

## Molecular Storage of Mg ions with Vanadium Oxide Nanoclusters

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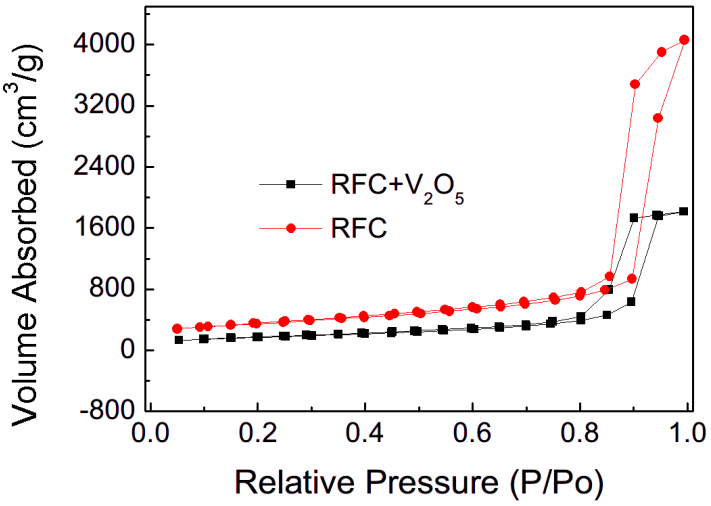


Figure S1: Nitrogen absorption isotherm for RFC and RFC/$V_2O_5$ composites.

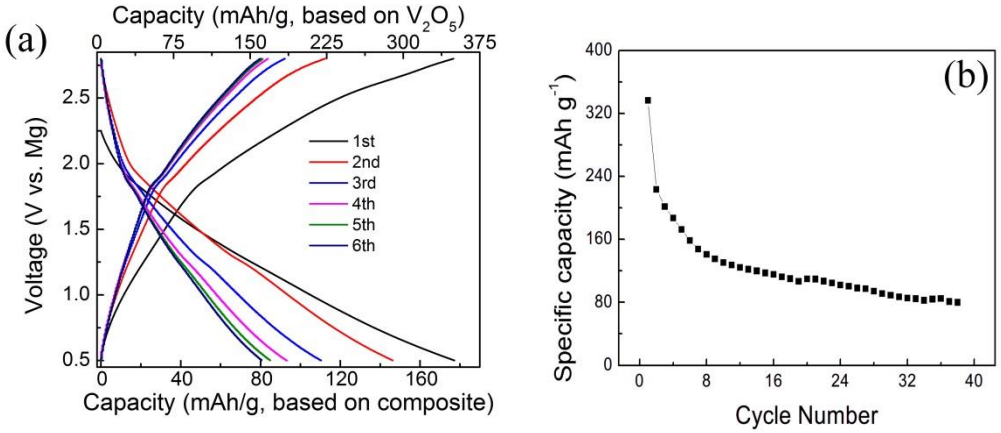

Figure S2: (a) The initial five charge-discharge cycles for the $V_2O_5$/RFC composite electrode in the Mg electrolyte at 40 mA $g^{-1}$ and (b) the cyclic stability.

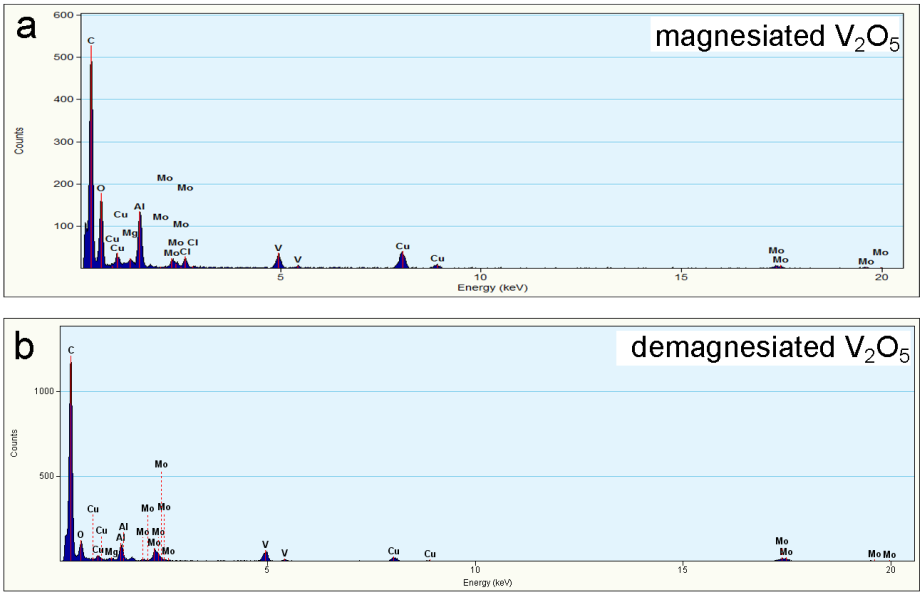


Figure S3: EDS spectrum of (a) magnesiated and (b) demagnesiated $V_2O_5$ electrodes that shows reversible changes in Mg peaks intensity with respect to V. Mo peaks was from the cathode current collector, and Al and Cl peaks were from the electrolyte.

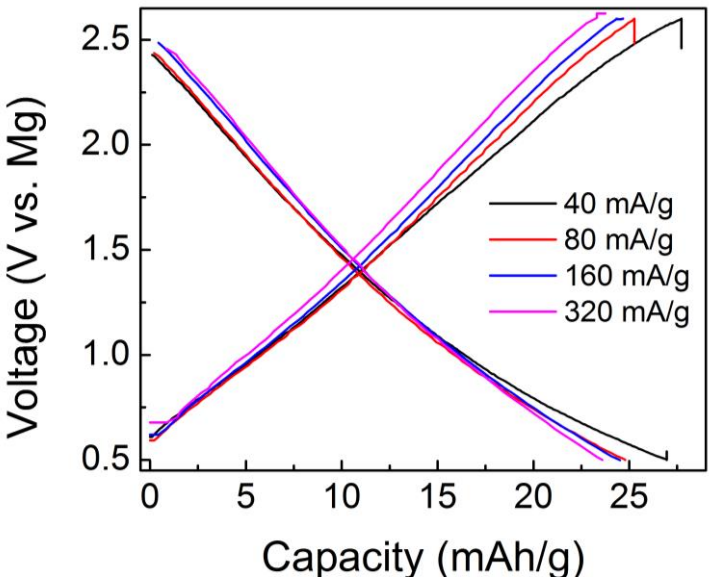


Figure S4: Charge-discharge profile of RFC in the electrolyte of 0.2 M $[Mg_2(\mu\text{-}Cl)_2(DME)_4][AlCl_4]_2$ in dimethoxyethane (DME).

Table S1: Atomic percentage (%) analysis results determined from XPS spectra.

| | C | O | F | V | N | Mg | Al |
|---|---|---|---|---|---|---|---|
| Pristine composite | 69.8 | 13.9 | 10.3 | 4.6 | 1.4 | N.A. | N.A. |
| Magnesiated compsoite | 44 | 33.2 | 6.5 | 4.0 | 1.1 | 3.0 | 3.5 |
| demagnesiated composite | 70.4 | 15.8 | 7.3 | 2.6 | <0.1 | 0.2 | 1.5 |

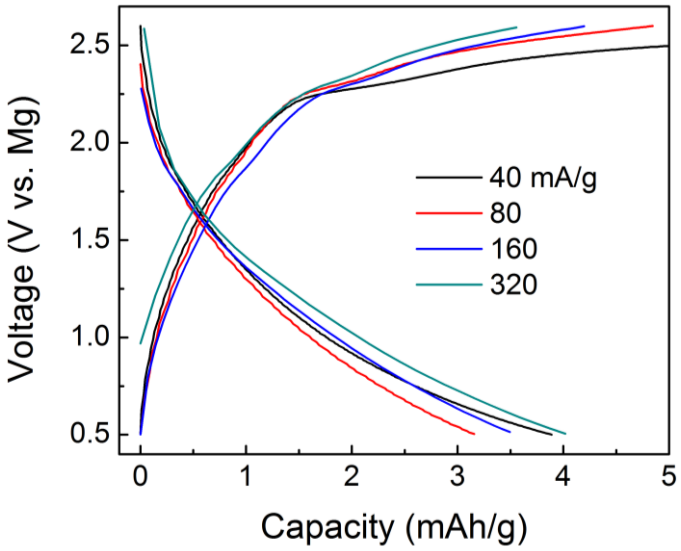


Figure S5: Charge-discharge behavior of bulk, crystalline $V_2O_5$. This material did not show appreciable capacity.

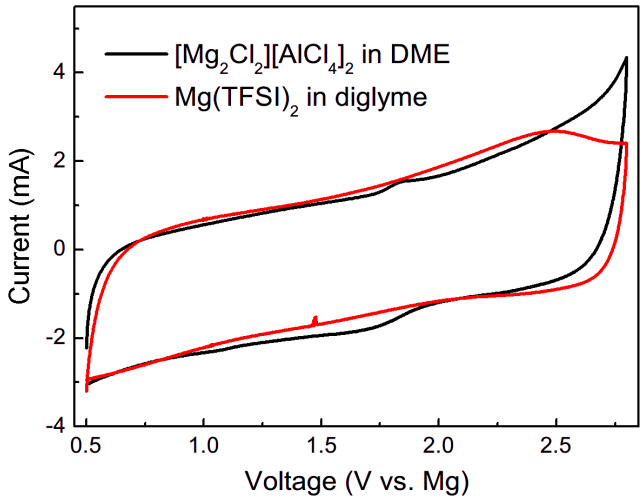


Figure S6: Comparison of CV of $V_2O_5$/RFC electrodes in different electrolytes, the scan rate was 10 mV/s.