Ultra-Reduced and Protonated Aqueous Solutions of Polyoxometalate Clusters for Flexible Energy Storage

Leroy (Lee) Cronin*

School of Chemistry, The University of Glasgow, Glasgow, G12 8QQ

web: www.croninlab.com email: Lee.Cronin@Glasgow.ac.uk

As our reliance on renewable energy sources grows, so too does our need to store this energy to mitigate against troughs in supply. Energy storage in batteries or by conversion to chemical fuels are the two most flexible and scalable options, but are normally considered mutually exclusive. Energy storage solutions that can act as both batteries and fuel generation devices (depending on the requirements of the user) could therefore revolutionize the up-take and use of renewably-generated energy. Herein, we present a polyoxoanion, [P2W18O62]6−, that can be reversibly reduced and protonated by 18 electrons/H+ per anion in aqueous solution, and which can act either as a high-performance redox flow battery electrolyte (giving a practical discharged energy density of 225 Wh L−1 with a theoretical energy density of more than 1000 Wh L−1), or as a mediator in an electrolytic cell for the on-demand generation of hydrogen.

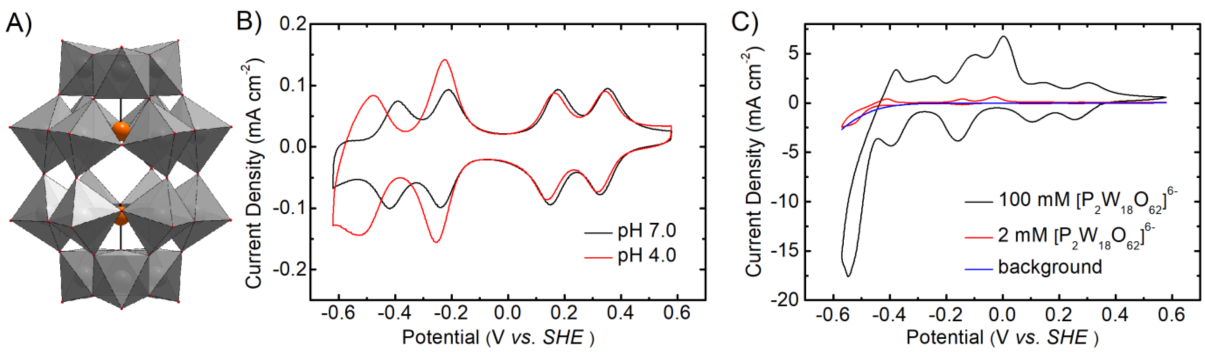

Figure 1. The structure and basic electrochemistry of $[P_2W_{18}O_{62}]^{6-}$. **A:** The structure of $[P_2W_{18}O_{62}]^{6-}$ (tungsten octahedra in grey and phosphorus in orange). **B**: CVs of a 2 mM solution of $Li_6[P_2W_{18}O_{62}]$ in 1 M Li_2SO_4 (pH 7, black line) and in 1 M Li_2SO_4/H_2SO_4 (pH 4, red line) at a scan rate of 10 mV s^{-1}. **C:** CVs of a 2 mM solution (red line) and 100 mM solution (black line) of $Li_6[P_2W_{18}O_{62}]$ in 1 M H_2SO_4 and a CV of just 1 M H_2SO_4 for comparison (blue line). The scan rate was 10 mV s^{-1}.