Supporting information

WO₃ based solid solution oxide – promising proton exchange membrane fuel cell anode electro-catalyst

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**Section S1:** The possible reaction scheme for the formation of WO$_3$ from sodium tungstate dehydrate (Na$_2$WO$_4$.2H$_2$O) is given as \(^1\):

\[
\text{Na}_2\text{WO}_4 + 2\text{HCl} \rightarrow \text{H}_2\text{WO}_4 + 2\text{NaCl}
\]

\[
\text{H}_2\text{WO}_4 \rightarrow \text{WO}_3 + \text{H}_2\text{O}
\]

In the synthesis of WO$_3$ from Na$_2$WO$_4$.2H$_2$O, hydrated tungsten trioxide (H$_2$WO$_4$) is obtained as a precipitate and forms pure WO$_3$ upon further heat treatment. To determine the temperature of heat-treatment of H$_2$WO$_4$ and thus, to obtain pure WO$_3$, thermogravimetric analysis (TGA) was conducted in ultra-high purity Argon (UHP-Ar) atmosphere (Flow rate=40 ml/min) as shown in **Fig. S1**. TGA results show that there is a steady loss in weight up to \(~320^\circ\text{C}\) indicative of a transformation of H$_2$WO$_4$ to WO$_3$ (expected weight loss \(~7.2\%)\). Hence, heat-treatment of H$_2$WO$_4$ was carried out at 350\(^\circ\text{C}\) for 2 h to obtain pure WO$_3$. 
Figure S1: TGA plot of H$_2$WO$_4$ powder in UHP-Argon atmosphere showing the weight loss.
Figure S2: Method of multiple small potential steps used on the RDE to reduce the contribution by charging current and current measurement was performed at the end of each step.2
Figure S3: Tafel plot of \((W_{0.8}Ir_{0.2})O_y\), before and after \(iR_\Omega\) correction.
Figure S4: Tafel plot of $(W_{0.7}Ir_{0.3})O_y$, before and after $iR_\alpha$ correction.
Figure S5: Tafel plot of IrO$_2$, before and after iR$_\Omega$ correction.
Figure S6: Tafel plot of Pt/C, before and after $iR_\Omega$ correction.
Figure S7: The linear scan voltammogram (LSV) curves for HOR of Pt/C obtained on rotating disk electrode (RDE) at different rotating speeds, measured in H₂ saturated 0.5 M H₂SO₄ solution at 40°C with a scan rate of 10 mV/sec. Koutechy-Levich plot of Pt/C is shown in the inset of LSV curve.
References:
