Crystallization and electrochemical properties of $K_xV_2O_5$ nano-ribbons obtained via solvothermal process as a promising cathode for PIBs

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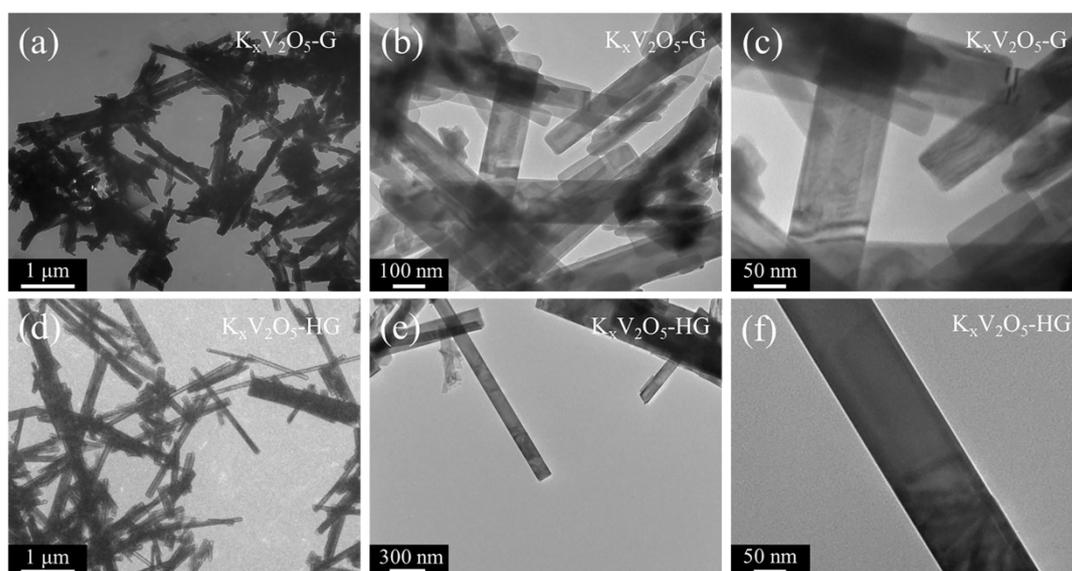Fig. S1 TEM images of $K_xV_2O_5$-G (a, b, c) and $K_xV_2O_5$-HG (d, e, f) at different magnifications.

As depicted in Fig. S1, $K_xV_2O_5$-HG (d, e, f) (that is, $K_xV_2O_5$-HG1 mentioned in experimental section) prepared by sol-gel process owns more uniform nano-ribboned morphology. It is conducive to the potassium storage performance. $K_xV_2O_5$-HG has a relatively longer length of ~ 2-5 μm and smoother surface compared to $K_xV_2O_5$-G (a, b, c). However, the length of $K_xV_2O_5$-G is shorter and its agglomeration is also more

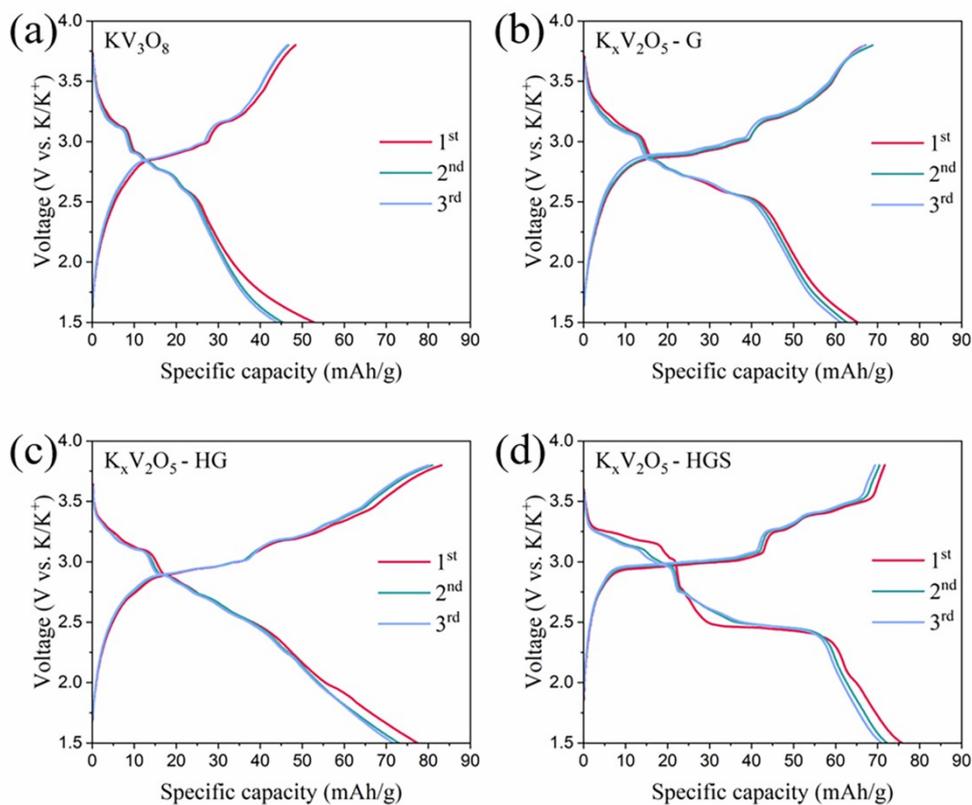obvious, which is synthesized by introducing glucose only in hydrothermal condition.

Fig. S2 Initial three galvanostatic charge/discharge (GCD) profiles for KV_3O_8 (a), $K_xV_2O_5$-G (b), $K_xV_2O_5$-HG (c) and $K_xV_2O_5$-HGS (d) at 50 mA/g between 1.5-3.8 V.

It can be seen from Fig. S2 that the voltage plateaus and curve profiles of KV_3O_8 (a), $K_xV_2O_5$-G (b), $K_xV_2O_5$-HG (c) and $K_xV_2O_5$-HGS (d) only display little changes for their initial three cycles. So, the significant changes in plateaus and curve profiles are primarily caused by subsequent long-term cycling.
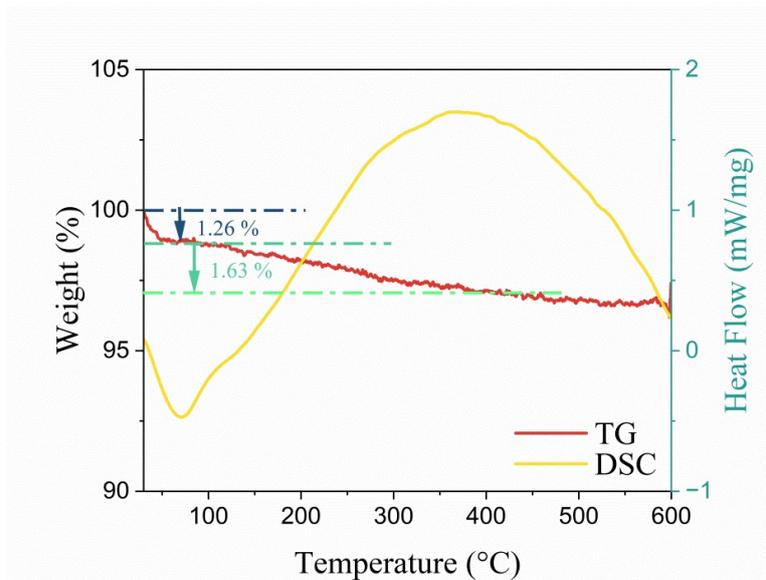
Fig. S3 TG-DSC of $K_xV_2O_5$-HG in Ar atmosphere.

TG-DSC was conducted at the temperature range of ~30 to 600 °C with a heating rate of 10 °C/min under inert Ar atmosphere in order to determine the rough content of crystalline water in $K_xV_2O_5$-HG. It can be observed that a weight loss of 1.26 % occurs between ~ 30 and 100 °C due to the evaporation of adsorbed water, accompanying by a downward endothermic peak in the region of 50-100 °C. Besides, another weight loss of 1.63 % happens between 100 and 400 °C owing to the release of deep crystalline water along with further crystallization of $K_xV_2O_5$-HG. Meanwhile, an upward exothermic peak appears between 200 and 600 °C, which is caused by the crystallization of $K_xV_2O_5$-HG. So, TG-DSC test manifests that K_xV_2O5-HG in our study contains a certain amount of bound water (~2.89 wt.%). Based on the analyses of XRD and XPS in this work, we believe that the value of x in $K_xV_2O_5$-HG is ~ 0.5. Hence, it can be estimated that $K_xV_2O_5$-HG contains ~ 0.33 of bound H_2O, which can be ultimately written as $K_{0.5}V_2O_5 \cdot 0.33H_2O$-HG. As the writing of this chemical formula involves several approximations, it is more universal by utilizing K_xV_2O5-HG in the main manuscript.