

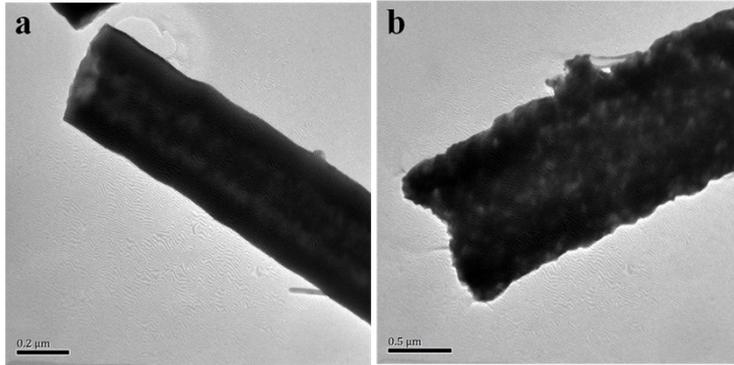
## Supplementary information

### Hollow porous titanium nitride tubes as cathode electrode for extremely stable Li-S battery

Dingrong Deng,<sup>a</sup> Taihua An,<sup>a</sup> Yijuan Li,<sup>a</sup> Qihui wu,<sup>b</sup> Mingsen Zheng,<sup>\*a</sup> and

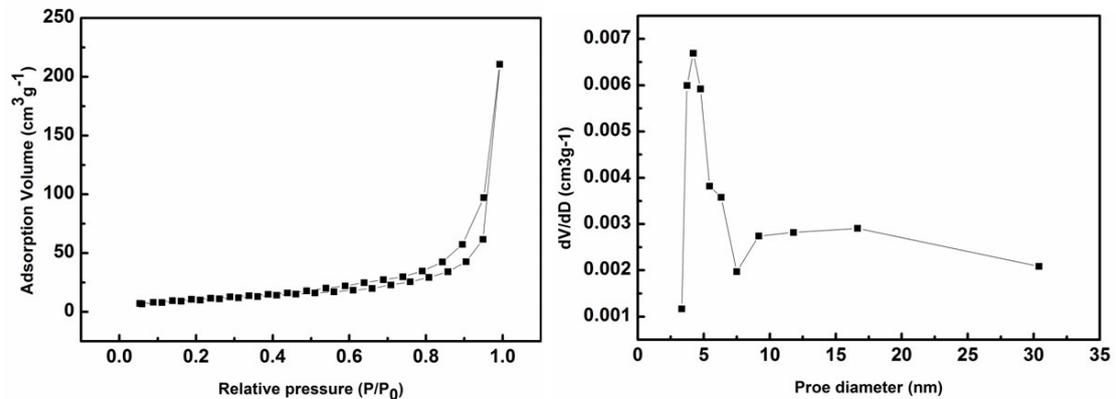
Quanfeng Dong<sup>\*a</sup>

- a. Department of Chemistry, College of Chemistry and Chemical Engineering, Xiamen University Collaborative Innovation Centre of Chemistry for Energy Materials, State Key Lab. of Physical Chemistry of Solid Surfaces, Xiamen, Fujian, 361005, China.  
E-mail: qfdong@xmu.edu.cn, mszheng@xmu.edu.cn;  
Fax: (+86)0592-2183905; Tel: (+86)0592-2185905.
- b. Department of Materials Chemistry, School of Chemical Engineering and Materials Science, Quanzhou Normal University, Quanzhou, 362000, China.

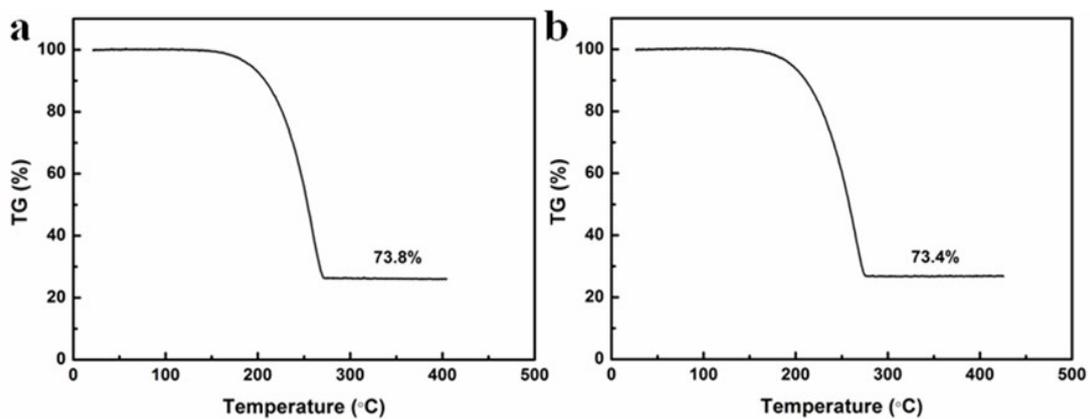


**Fig. S1** TEM images of TiO<sub>2</sub> tubes (a) and hollow TiN mesoporous tubes (b).

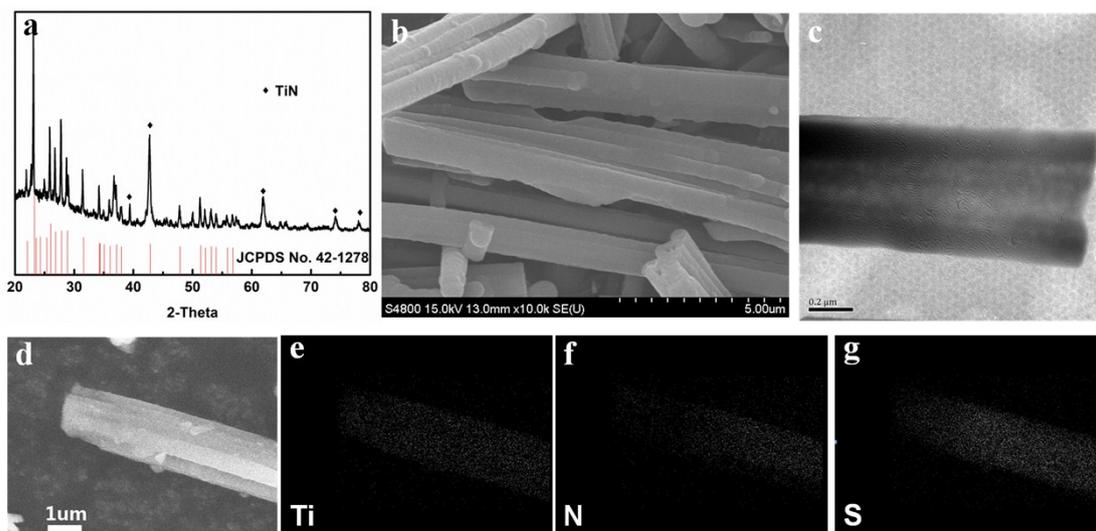
The TEM images shows both of TiO<sub>2</sub> tubes and TiN tubes are hollow tubular structure. Because the wall is too thick, the hollow structure in the TEM images is no too obvious.



**Fig. S2** N<sub>2</sub> adsorption-desorption isotherm loop and pore-size distribution plot of TiN mesoporous tubes.

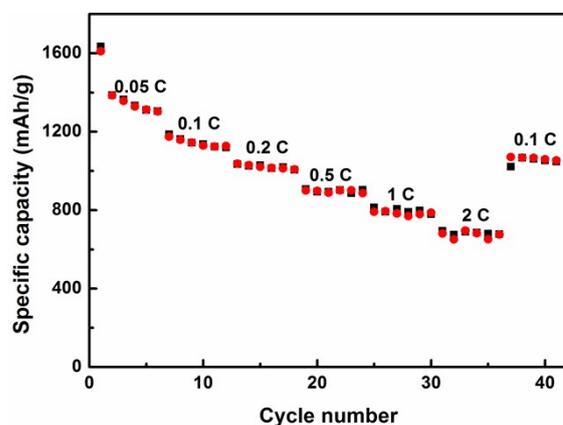


**Fig. S3** TG curve of 70TiN/S (a) and 70Sup P/S(b). The lost weights have given the sulfur loadings of 73.8% and 73.4%, respectively.

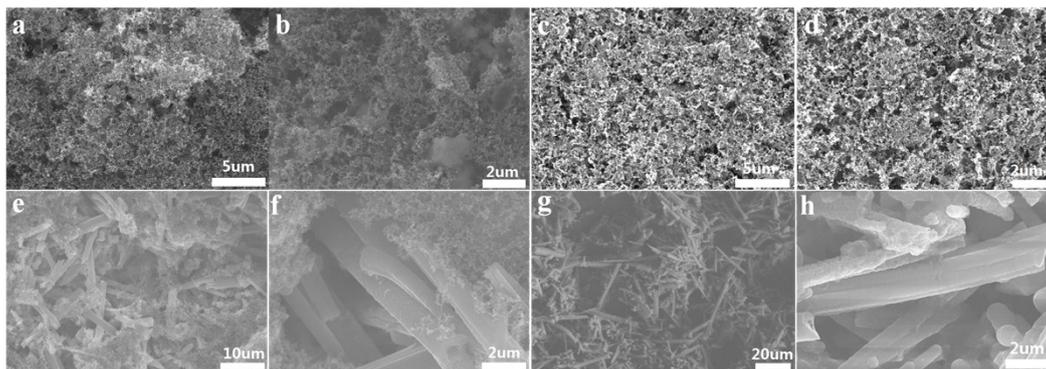


**Fig. S4** The characterization of the 70TiN/S sample. (a) XRD patterns of 70TiN/S, (b) SEM images of 70TiN/S, (c) TEM images of 70TiN/S, (d-g) SEM image and corresponding elemental mappings of 70TiN/S.

The XRD results prove the presence of sulphur. And as shown in the SEM image, the surface of 70TiN/S become more smooth than TiN tubes, and there are a little additional sulfur particles in the sample, most of the sulphur is distributed in the framework of TiN tube, and SEM elemental mappings 70TiN/S further confirm that.

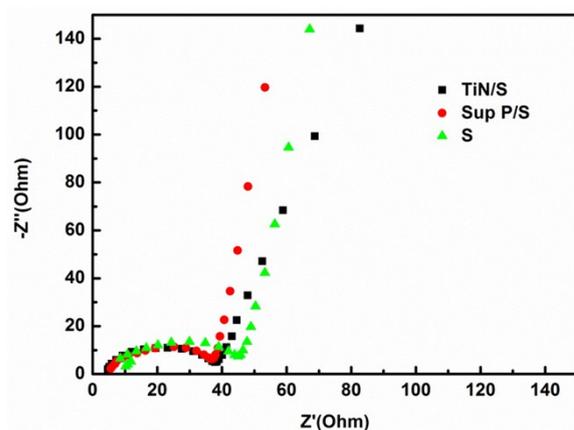


**Fig. S5** Rate capability of 70TiN/S at different current rates.



**Fig. S6** SEM images of the different type electrode films. (a)(b) S with 20% super P electrode, (c)(d) 70Sup P/S with 20% super P electrode, (e)(f) 70TiN/S with 20% super P electrode, (g)(h) 70TiN/S with 20% TiN electrode.

The SEM images of (a)-(d) shows that there are some sulfur bulks in the surface of S with 20% super P the electrode, and there is nearly no sulfur particle naked in the surface of 70Sup P/S with 20% super P electrode. (e)(f) shows that in 70TiN/S with 20% super P electrode, super P nanoparticles and 70TiN/S tubes are mixed together, the morphology of 70TiN/S were maintained. In images (g) and (h), there are all tubular structure in the electrode, only a little tubes were broken in the mixing, most of the tubes were maintained.



**Fig. S7** Electrochemical impedance spectra of 70TiN/S, 70Sup P/S, and sulfur (100S). The cathode electrode consists of 70 wt% active material (70TiN/S, 70Sup P/S, and sulfur), 20 wt% super P, and 10 wt% binder (LA).