Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Method:

Materials: Mg (99%, 200 mesh powder), HCl (37%) and commercial Si (99.5%, 200 mesh) were purchased from Sinopharm Chemical Reagent Co., Ltd (China).

Nano-silicon preparation process: Typically, 11.2 g of commercial bulk Si and 20.2 g of Mg were mixed and added into a 50 mL stainless autoclave before sealed. The Si:Mg molar ratio was 1:2.1, which was slightly in excess of Mg (5%), considering the complete reduction of Si into Mg_2Si. Subsequently, the autoclave was maintained at 500 °C for 10 h and cooled to room temperature to prepare the Mg_2Si/Mg. Then the Mg_2Si/Mg powder was heated at 600 °C under the air atmosphere for 10 h. heating at 600 °C led to the oxidation of Mg_2Si into Si/MgO and the excess Mg into MgO. The as-resulting production was immersed in hydrochloric acid (1 M) for 30 minute to remove MgO. The resultant solution was washed with distilled water and the brown-black precipitate was collected by filter, washed with deionized water and ethanol and dried for overnight at 60 °C in vacuum oven. The mass of the final nano-silicon production is above 10 g, which means the yield of nano-silicon from the sand conversion is above 90%. The percentage yields of this nanoporous silicon material are calculated in supporting information and several repeated experiments have been tested **(Table S1)**.

***Material Characterization*:** The morphology of the materials were characterized by scanning electron microscopy (SEM, JEOL-JSM-6700F), Transmission electron microsocopy (TEM, Hitachi H7650 and HRTEM, JEOL 2010). X-ray diffraction (XRD) was performed on a Philips X' Pert Super diffract meter with Cu Kα radiation (λ=1.54178 Å).

The Brunauer- Emmett-Teller (BET) surface area and Barrett-Joyner-Halenda (BJH) pore distribution plots were measured on a Micromeritics ASAP 2020 accelerated surface area and porosimetry system. The tap density were measured on a JZ-1 powder tap density meter (Chengdu Jingxin Powder Analyse Instrument Co.,LTD). Before measurement, the samples were allowed to dry under vacuum at 110 °C for 3h.

Electrochemical Measurement: The electrochemical properties of nano-silicon electrodes were measured with coin-type half cells (2016 R-type) which assemble under an argon-filled glove box (H_2O, O_2 < 1 ppm). Working electrode was prepared by mixing the nano-silicon material, super P carbon black and sodium alginate (SA) binder in a weight ratio of 60:20:20 in water solvent. The slurry was pasted onto a Cu foil and then dried in a vacuum oven at 80 °C for 12 h. The active material density of each cell was determined to be 0.7-1.2 mg cm^{-2}. Metallic Li sheet was used as counter electrode, and 1 M $LiPF_6$ in a mixture of ethylene carbonate/dimethylcarbonate (EC/DMC; 1:1 by Volume, Zhuhai Smoothway Electronic Materials Co., Ltd (china). Galvanostatic measurements were made using a LAND-CT2001A instrument at room temperature that was cycled between 0.005 V and 1.50 V versus Li^+/Li at a rate of 0.36 A g^{-1} to 36 A g^{-1}.

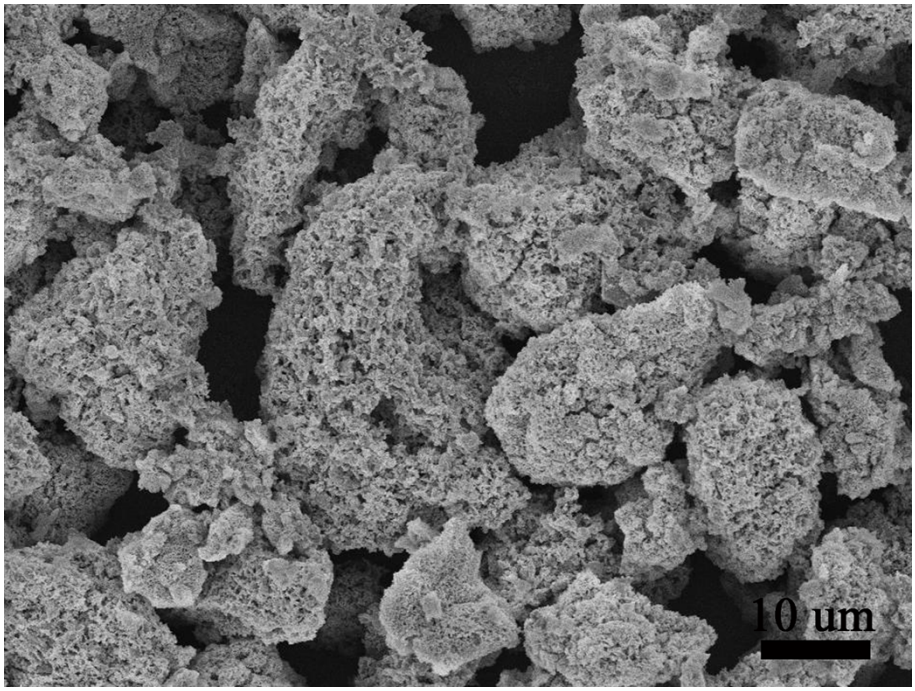

Figure S1. SEM image of the as-prepared nano-porous Si.

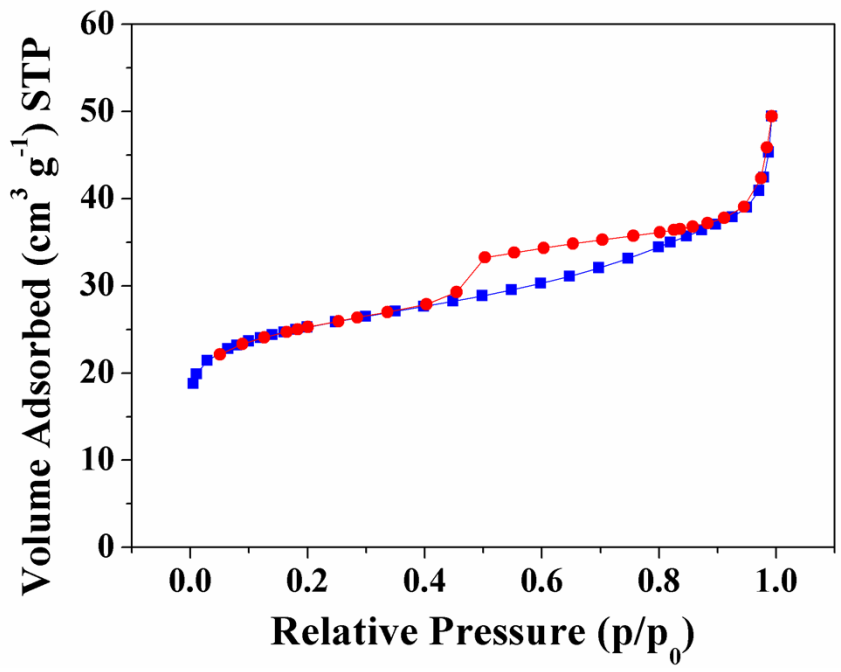

Figure S2. Nitrogen adsorption curves of the nano-porous Si powder.

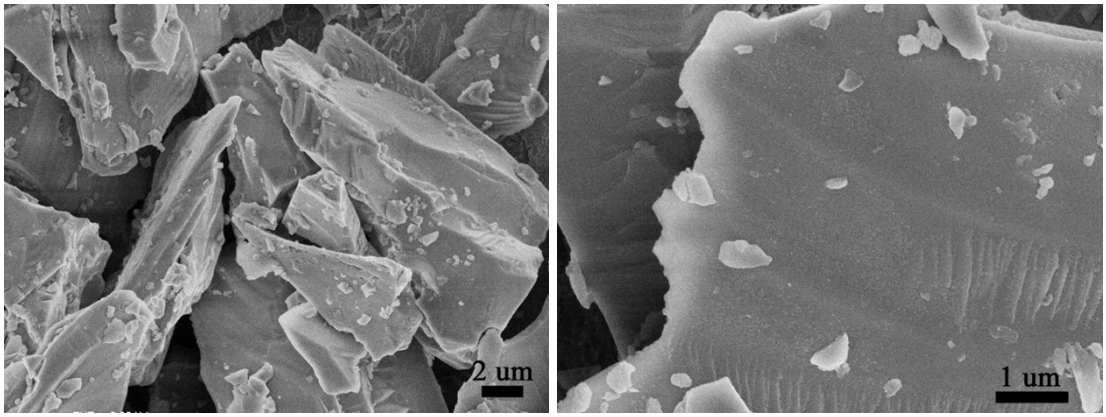

Figure S3. SEM image of the commercial bulk Si.

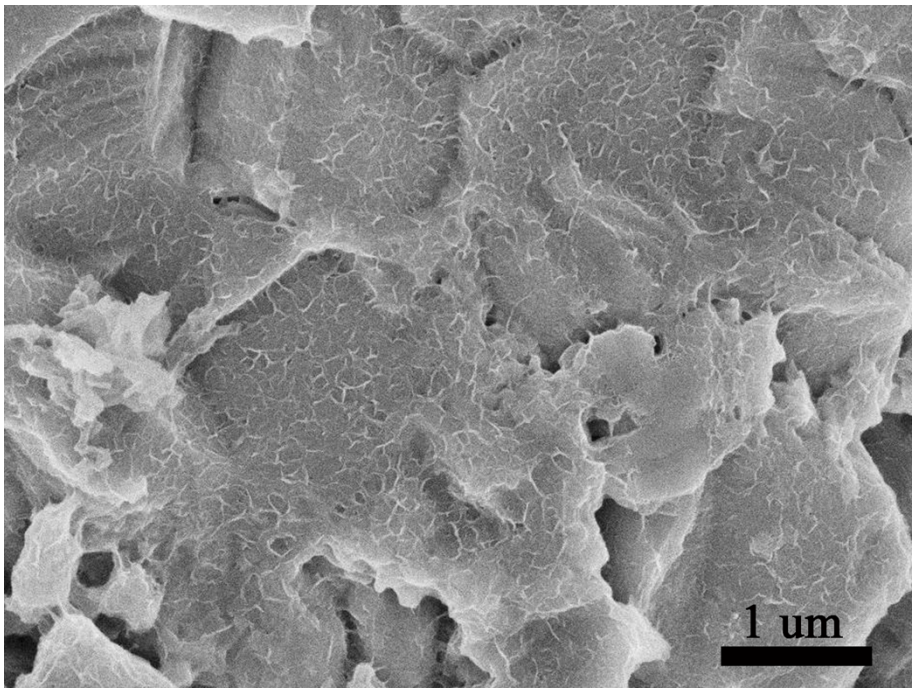

Figure S4. SEM image of the as-prepared Mg_2Si/Mg after the Mg-Si reaction.

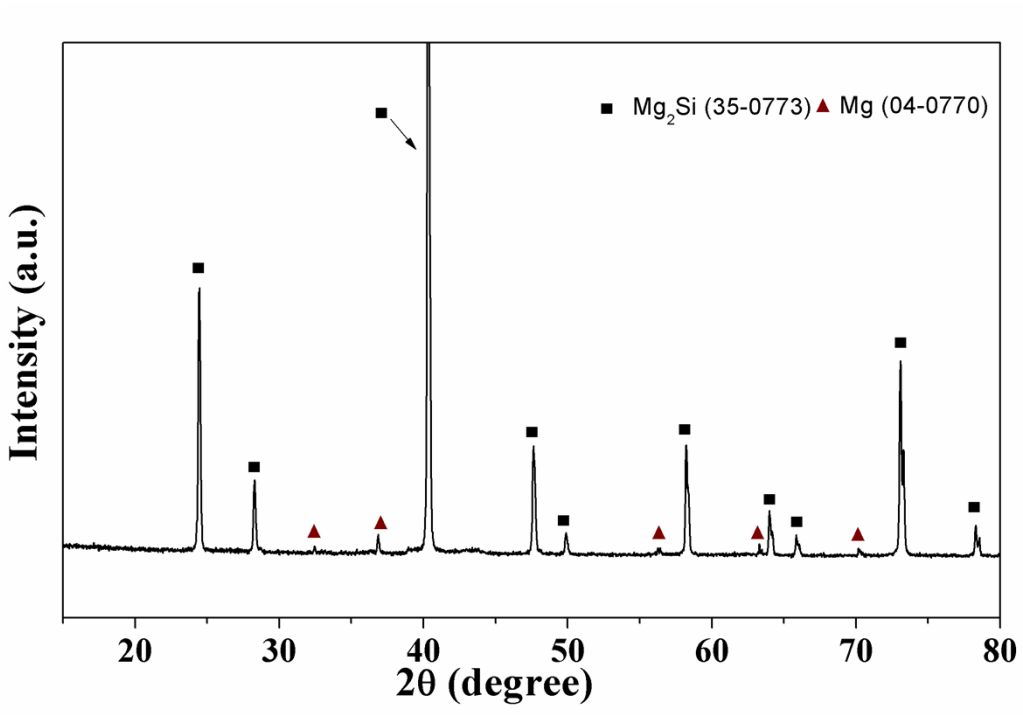

Figure S5. XRD patterns of as prepared powder before acid washing at air-oxidation temperatures of 400 °C for 10 h.

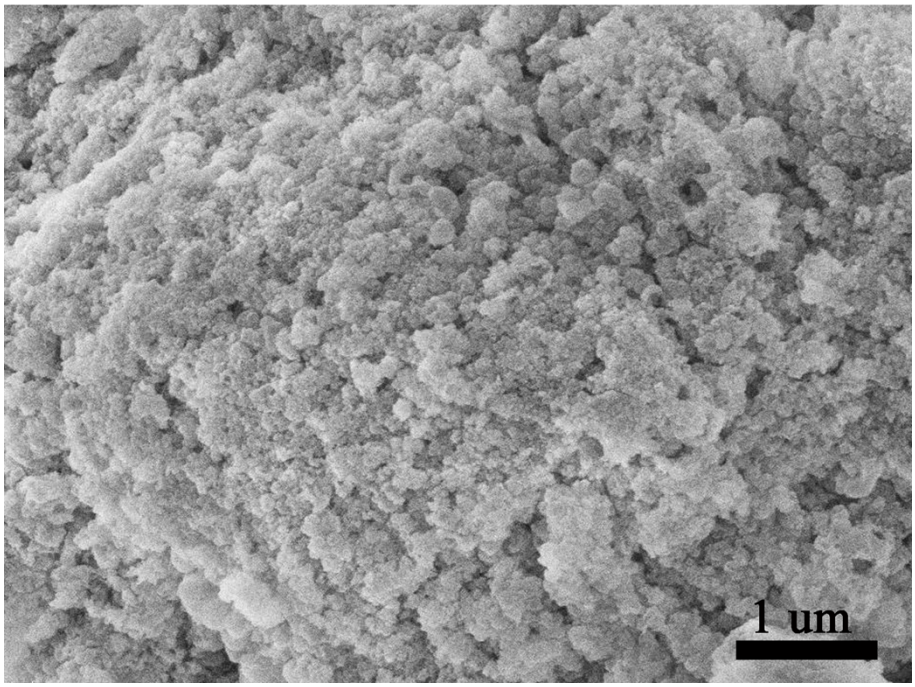

Figure S6. SEM image of the MgO/Si compound after oxidation process in air.

Table S1. The repeated experiments of nano-porous silicon and these corresponding conversion yields and tap density.

	Commercial Bulk Si	After air oxidation	Porous Si	Yield	Tap density
1	10.585 g	42.24 g	10.465 g	98.8 %	0.603 g cm^{-3}
2	11.653 g	46.24 g	11.261 g	96.6 %	0.579 g cm^{-3}
3	10.039 g	39.68 g	9.544 g	95.1 %	0.584 g cm^{-3}
4	10.927 g	43.12 g	9.898 g	90.6 %	0.628 g cm^{-3}
5	11.353 g	42.00 g	10.922 g	96.2 %	0.592 g cm^{-3}