

Supporting Information

Experimental

Preparation of SiNV: 1 g of fumed SiO₂, 2.34 g of NaCl and 2.98 g of KCl was thoroughly ground along with 1g of Mg powder and then sealed in a stainless steel autoclave reactor. The reactor was put in a furnace and heated to 700 °C with a ramp rate of 5 °C min⁻¹ and finally it was held at 700 °C for 10 h. After this process, the reactor was taken out of the furnace when the temperature fell below 100 °C. The obtained powders were immersed in 1M HCl solution for several hours to remove NaCl, KCl and MgO. After that, the solution was centrifuged (8000 rpm, 10 min) and washed for several times to collect SiNV. The obtained SiNV were dissolved in 10 wt% dilute HF solution for 10 min to remove unreacted silica during magnesium reduction. The yellow-brown precipitate was collected by centrifuge and dried at 70 °C for overnight in vacuum oven to evaporate rest solvent.

Characterization: The morphology of the reaction product were characterized by scanning electron microscopy (SEM, JEOL-JSM-6700F), transmission electron microscopy (TEM, Hitachi H7650 and HRTEM, JEOL 2010). X-ray diffractometer (XRD) was performed on a Philips X' Pert Super diffract meter with Cu K α radiation ($\lambda=1.54178 \text{ \AA}$). The nitrogen adsorption and desorption isotherms were measured with a VELSORP-mini II (BEL Japan, Inc.) at 473 K in the relative pressure range of P/P₀ from 0 to 1 to determine the Brunauer–Emmett–Teller (BET) surface areas and pore size distribution. Raman spectrum was performed gth to check the compositions and the carbon content of the product was check by Ewith 514.5 nm wavelenA (Vario EL-III) and TGA. Raman spectrum was performed with 514.5 nm wavelength to check the compositions and the carbon content of the product was check by EA (Vario EL-III). The percentage yields of this SiNV material are calculated based on the formula as: $Y = m_E / m_T$. Where Y is the conversion yield, m_E is the mass of the experimental silicon production, and m_T is the mass of the theoretical silicon production. In our synthesis process, a several repeated experiments have been tested. **Table S1** shows the data of four repeated experiments of the SiNV products and these corresponding conversion yields.

Electrochemistry Measure: The working electrodes were prepared by mixing the SiNV active materials with conductive additive carbon black (Super P, TIMCAL, Switzerland) and sodium alginate (SA) binder at a weight ratio of 60:20:20 in water solvent. The slurry was rolled into thin copper foil and then dried in a vacuum oven at 80 °C for 10 h. The dried electrode was punched into small circular disks with a diameter of 12 mm. The active materials mass loading is typically 1–1.5 mg cm⁻². The electrode was assembled in an argon-filled glove box (H₂O, O₂ < 1 ppm, Vacuum Atmospheres, Co.) by using a coin-type (CR2016) with polypropylene membrane (Celgard 2400) as the separator and 1 M LiPF₆ in EC/DEC as the electrolyte (1:1 by volume, Zhuhai Smoothway Electronic Materials Co., Ltd (china)). Galvanostatic cycling was done using a LAND-CT2001A battery tester. The voltage cutoffs are 0.005 and 1.50 V vs Li/Li⁺¹ at a rate of 0.36–10.8 A g⁻¹.

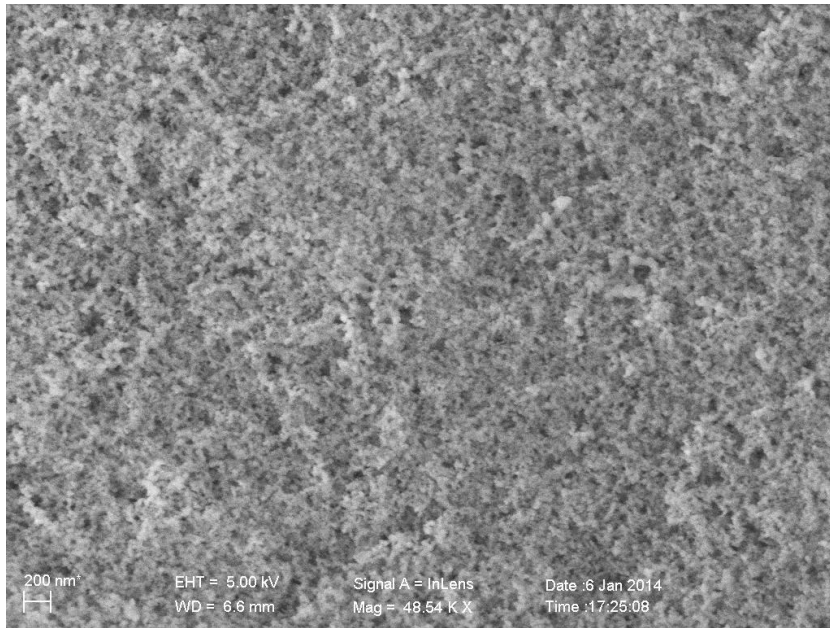


Figure S1. Scanning electron microscopy (SEM) images of the fumed SiO₂.

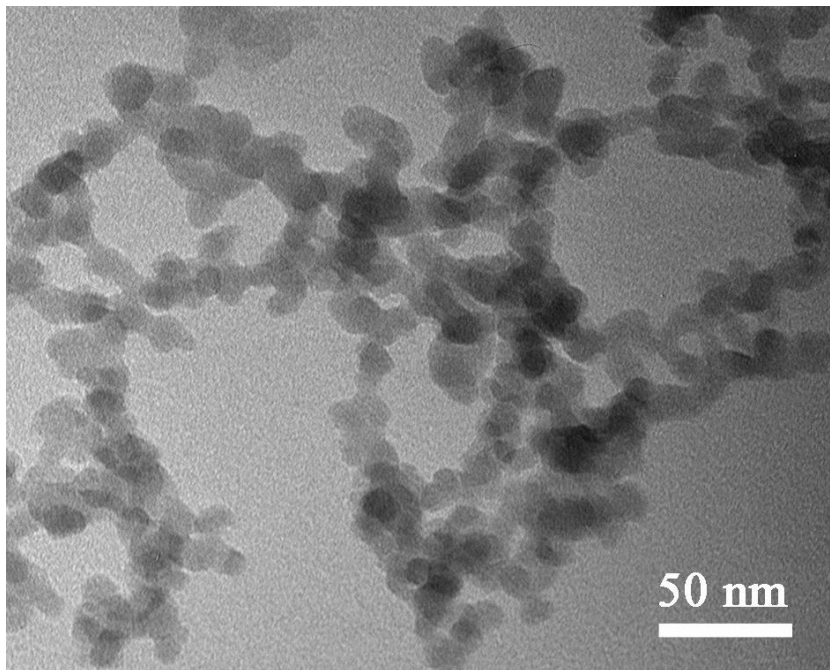


Figure S2. Transmission electron microscope (TEM) images of the fumed SiO₂.

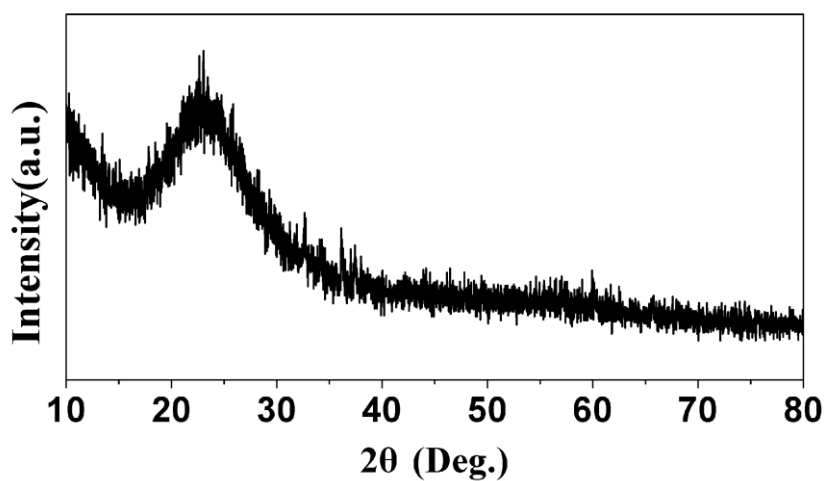


Figure S3. X-ray diffraction (XRD) pattern of the as-prepared fumed SiO₂.

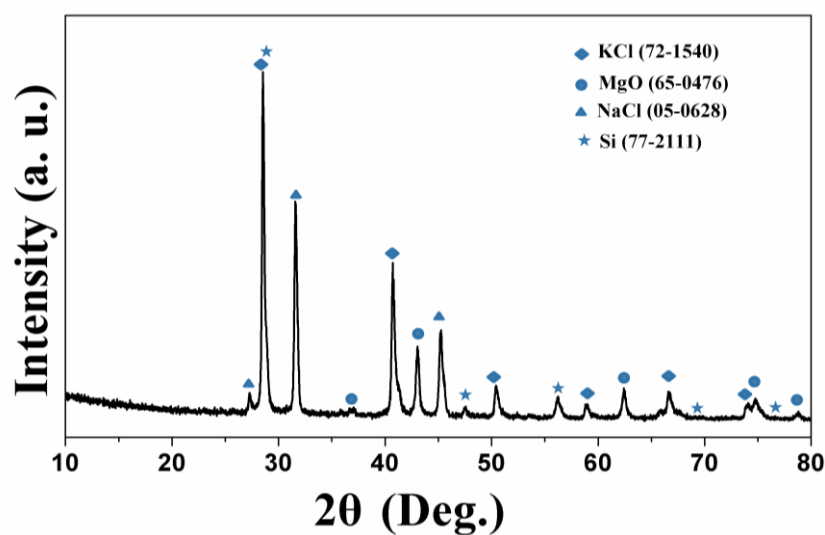


Figure S4. XRD pattern of agglomerated as-prepared reacted products after the MSMR reaction between fumed SiO₂ and Mg

Table S1. The repeated experiments of SiNV and these corresponding conversion yields.

	fumed SiO ₂	m _T	m _E	Y
1	1.025 g	0.478 g	0.391 g	81.8%
2	1.110 g	0.518 g	0.432 g	83.4%
3	0.998 g	0.461 g	0.384 g	83.3 %
4	1.030 g	0.481 g	0.406 g	84.4%

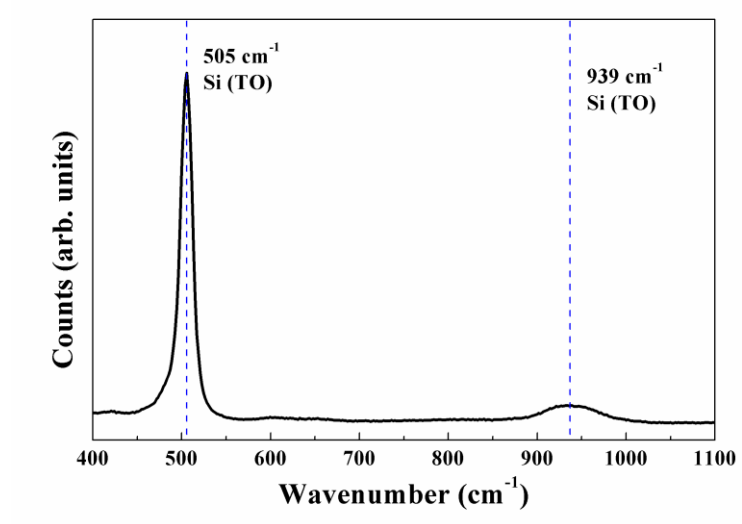


Figure S5. Raman spectra of the SiNV materials.

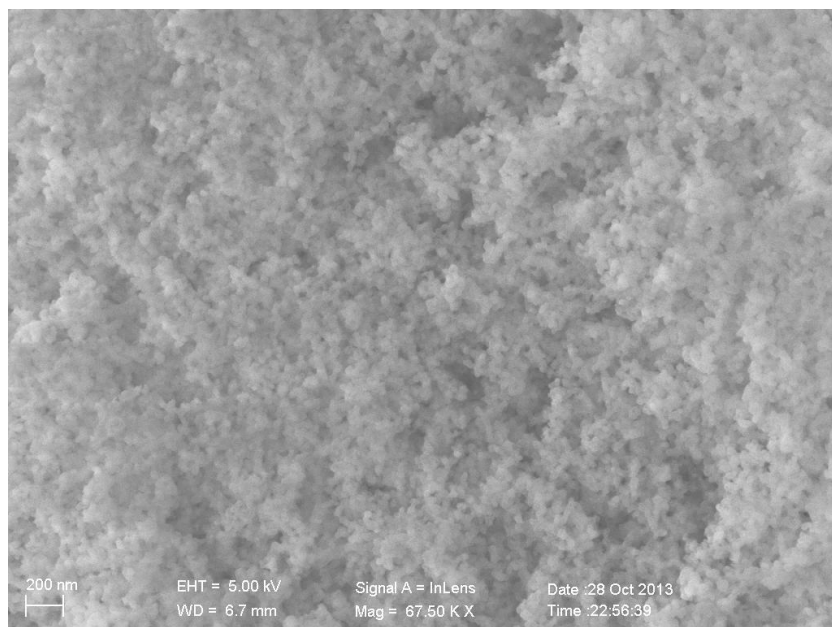


Figure S6. Large scale SEM image of agglomerated as-prepared reacted products.

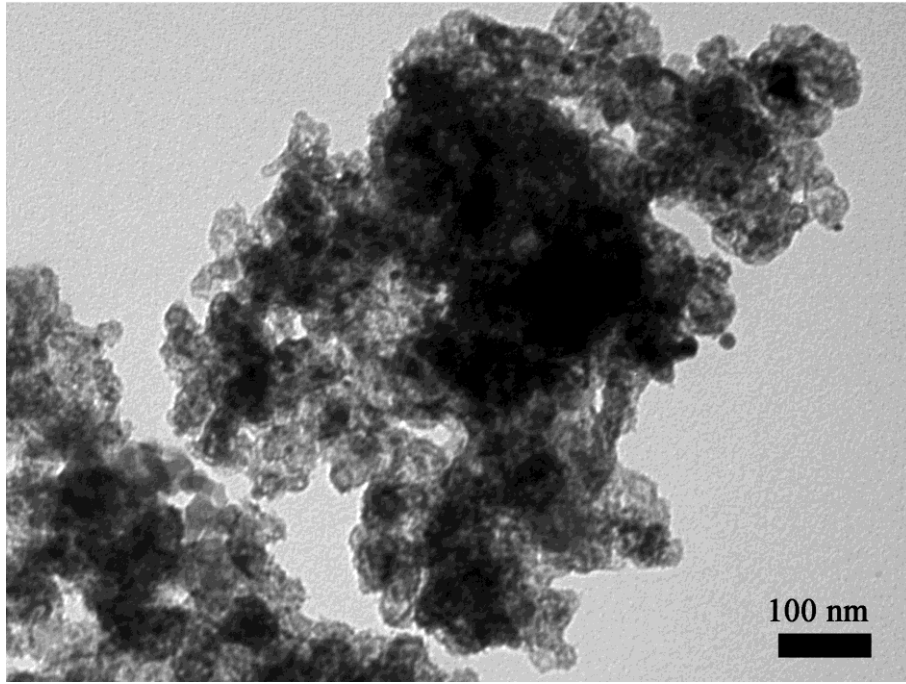


Figure S7. TEM image of the SiNV after 100 cycles.