Enhanced chemical stability of VO_2 nanoparticles by the formation of SiO_2/VO_2 core/shell structures and the application to transparent and flexible VO_2-based composite foils with excellent thermochromic properties for solar heat control

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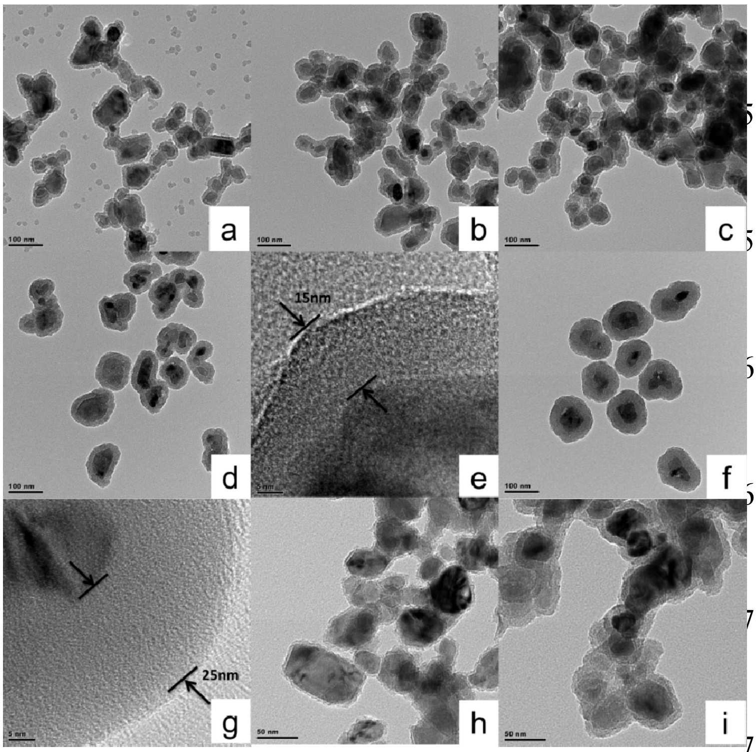
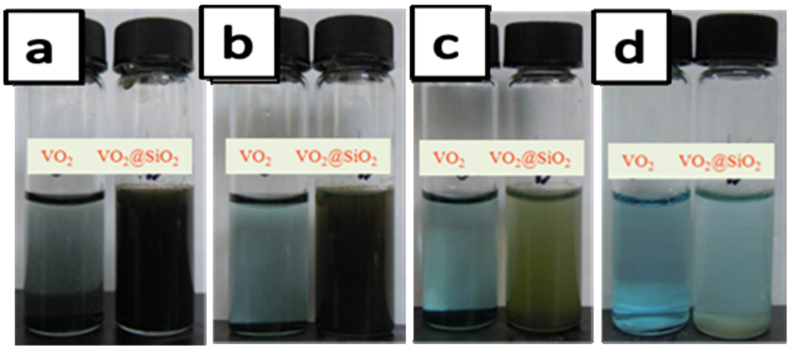


Supporting Figure S1. TEM images of $VO_2@SiO_2$ synthesised under different synthetic conditions (see Table 1 for details) (a) S1, (b) S2, (c) S3, (d) S4, (e) HRTEM image of S4, (f) S5, (g) HRTEM image of S5, (h) S6, and (i) S3. Silica shells with an average thickness of approximately 9 nm had already been deposited on the VO_2 surfaces after soaking for 3 h. By prolonging the time to 6 h, the number of homogeneous SiO_2 particles significantly decreased but remained observable, and the average thickness of the SiO_2 increased to approximately 13 nm. After soaking for 12 h, the separate SiO_2 particles nearly disappeared, but the thickness of the SiO_2 was nearly unchanged. Increasing the amount of added TEOS from 0.4 mL to 1 mL while leaving other parameters unchanged increased the silica shell thickness from approximate 15 nm to 25 nm.



Supporting Figure S2. Photographs of uncoated VO_2 nanoparticles and VO_2@SiO_2 nanoparticles in 0.1 M hydrochloric acid at room temperature for different durations: (a) 1 min, (b)10 min,(c) 20 min, and (d)1 h. The uncoated VO_2 immediately began to dissolve, and the solution appeared to be limpid. In comparison, the coated sample exhibited no obvious changes after the initial 1 min. When the exposure time was increased from 1 min to 20 min, the blue colour of VO^{2+} ions was easily seen, as shown in Supporting Figures S2 b-c, whereas the VO_2@SiO_2 exhibited a relatively slow dissolution rate. White SiO_2 was observed at the bottom of the bottle (Supporting Figure S2 d) after 1 h of reaction for the VO_2@SiO_2 particles.