Electronic Supplementary Information (ESI)

A molten-salt route for synthesis of Si and Ge nanoparticles: Chemical reduction of oxides by electrons solvated in salt melt

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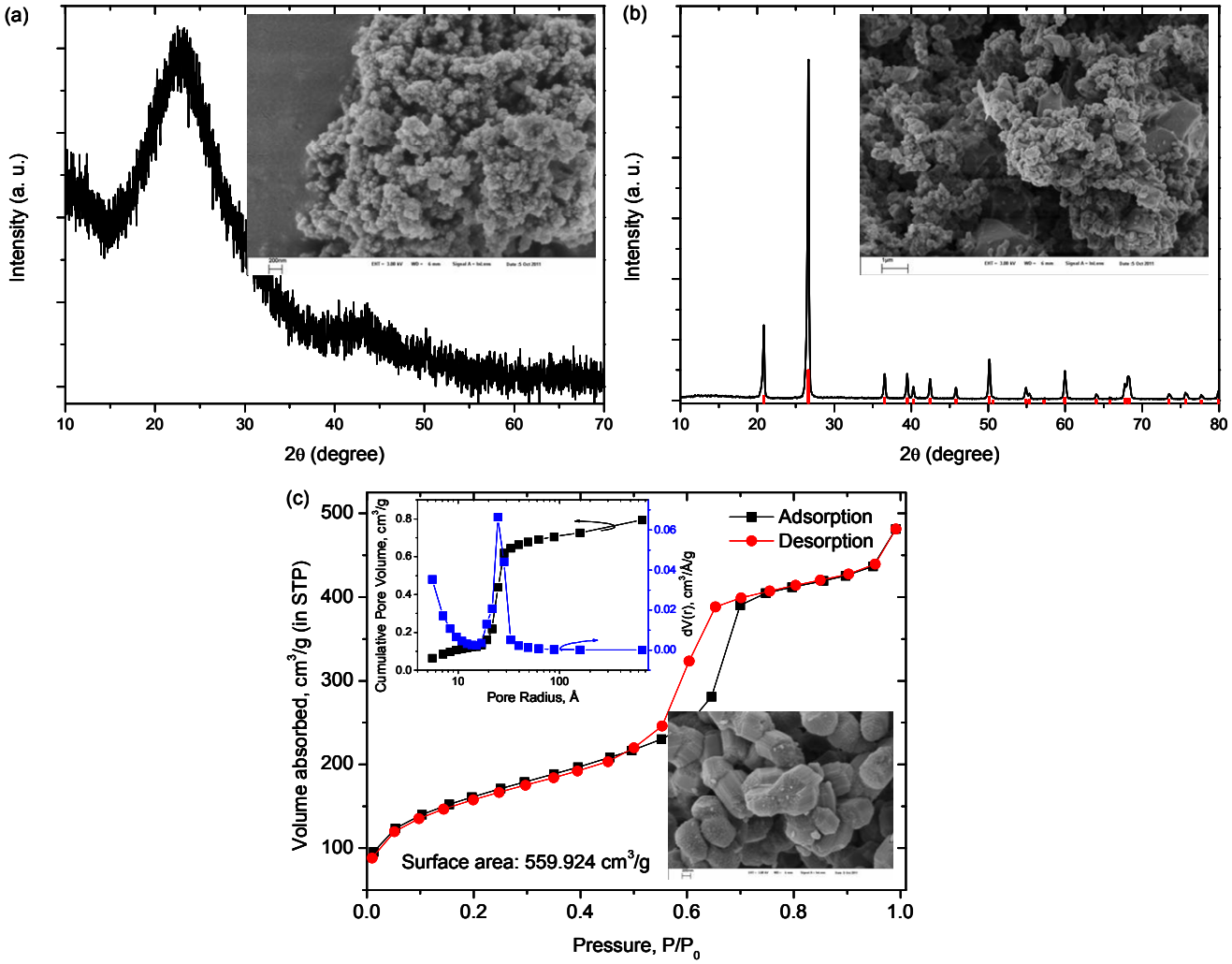

Fig. S1. Structural characterization for the different type of SiO_2 sources used as the starting materials: XRD patterns for (a) silica nanopowder and (b) micrometer-sized quartz powder, the inserts show the respective SEM images (note: it is shown by the SEM image that majority of big quartz crystals of micrometer size are covered by many small particles). (c) nitrogen-absorption isotherms for SBA-15, insert shows the pore radius distribution and the SEM image.

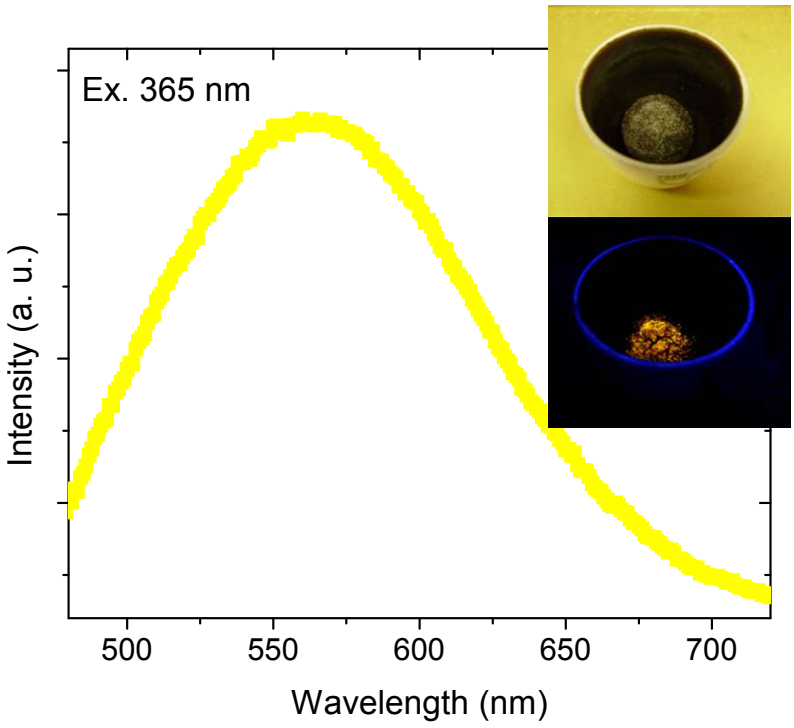

Fig. S2. Typical photoluminescence spectrum from the particles covering the surface of the as-received sample (without removal of the salts) under the excitation at 365 nm. The insert shows the pictures of the sample under natural light and ultra-violet light (Hg-365 nm line) illumination. However, the yellow luminescence disappear completely after removal of the salts by water, probably due to quenching effect incurred by -OH binding to the surface nanocrystals. Furthermore, it has to be noted here that the visible emission could be ascribed to Si quantum dots of 1-5 nm in size, [1, 2] which are much smaller than the Si NCs obtained from the bulk of the as-received samples considering the inhomogeneity of the reaction system. The mechanism of the Si QD formation, regeneration of the luminescence and the tuning of the emission color could be of interest, but are beyond the scope of the present work.

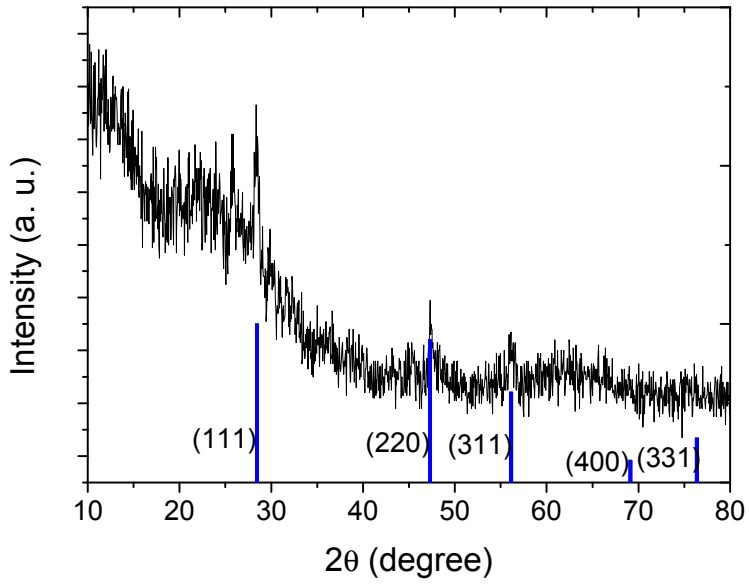

Fig. S3. XRD pattern of the Si nanoparticles synthesized at 550 °C. The amorphous hump centered at around 22° is due to the presence of unreacted silica (compared with Fig S1a). This sample is measured in the presence of un-removed silica because the yield is fairly low, below 5%.

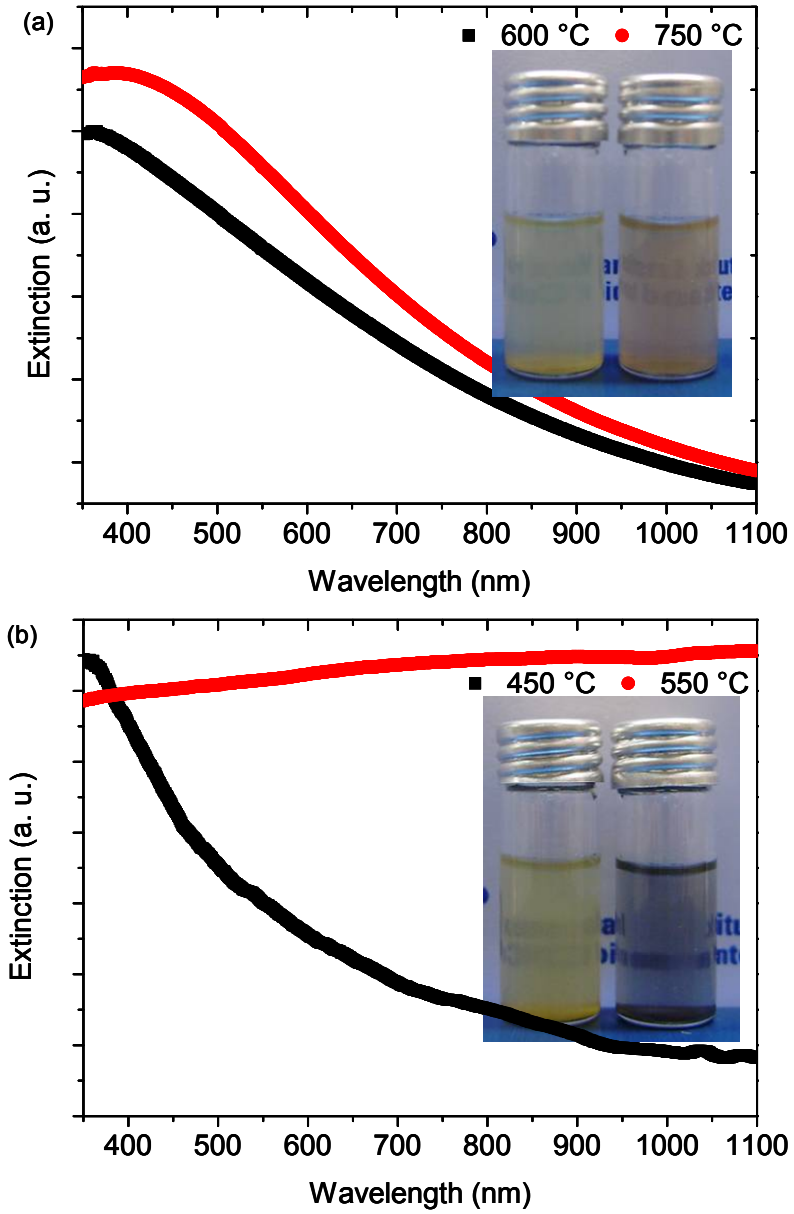

Fig. S4. Optical extinction (absorption+scattering) spectra for ethanol solutions of Si (a) and Ge (b) nanoparticles of different sizes synthesized at 600 °C and 750 °C for Si, and 450 °C and 550 °C for Ge. For samples obtained at the lower temperature, a clear blue shift of the absorption edge can be observed due to the smaller crystal size. For Ge nanoparticles obtained at 550 °C, the sample is black and absorbs light throughout the entire spectrum region we have measured.

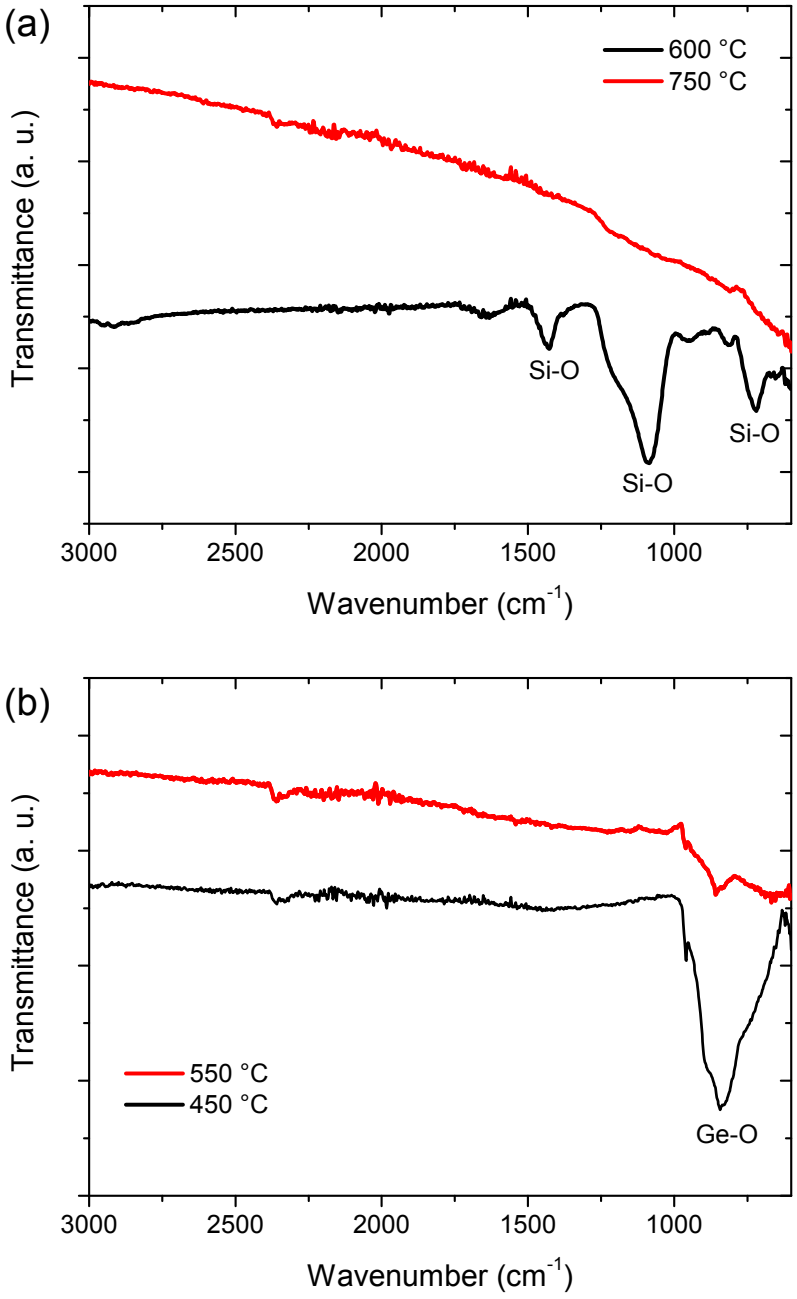

Fig. S5. Representative FT-IR spectra for (a) Si nanoparticles synthesized at 600 °C and 750 °C, and (b) Ge nanoparticles synthesized at 450 °C and 550 °C. It is indicated that a smaller particle size (for samples obtained at lower temperatures) lead to the increased surface oxidation for both of Si and Ge nanoparticles.

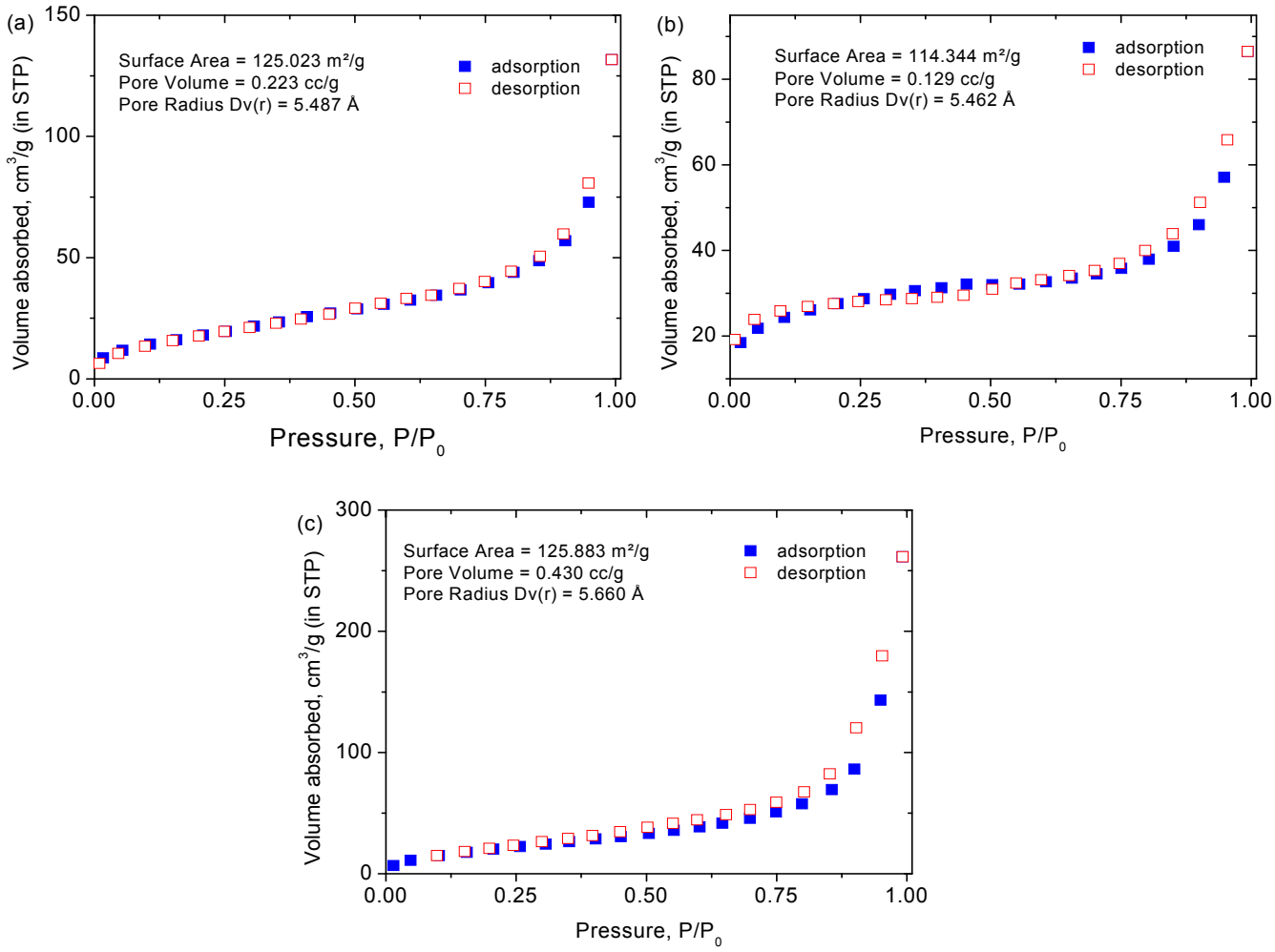

Fig. S6. Nitrogen absorption isotherms measured at 77 K for Si nanoparticles synthesized at 700 °C from different sources of silica: (a) SBA-15, (b) silica nanopowder and (c) silica (quartz) micrometer powder.

References

1. A. G. Cullis and L. T. Canham, *Nature*, **1991,** *353*, 335-338.

2. N. A. Hill and K. B. Whaley, *Phys. Rev. Lett.*, **1995**, *75*, 1130-1133.