Electronic Supplementary Information

Towards the understanding of formation of micro/nano holes of Ge/GeO_2 through phase mapping

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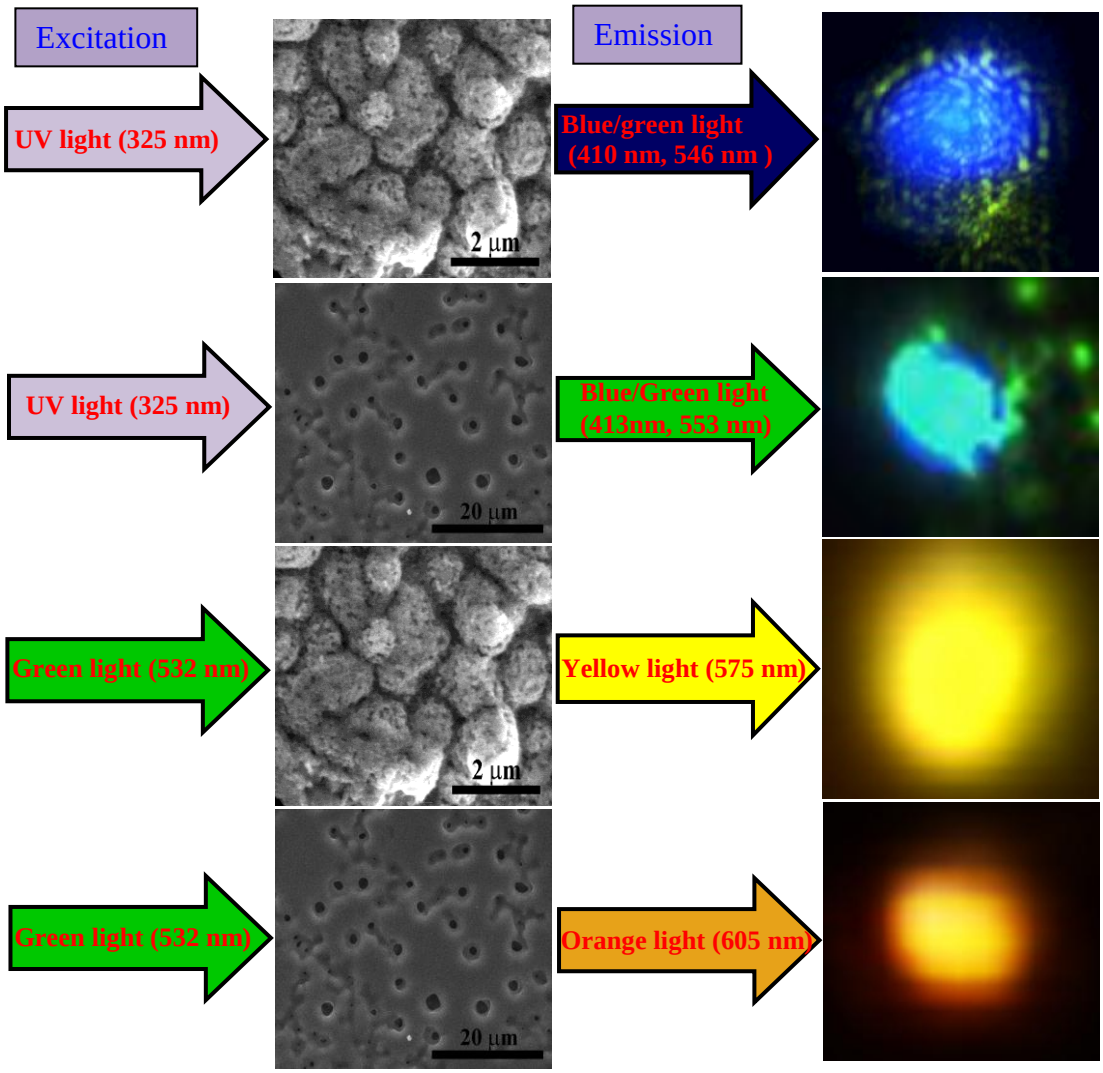

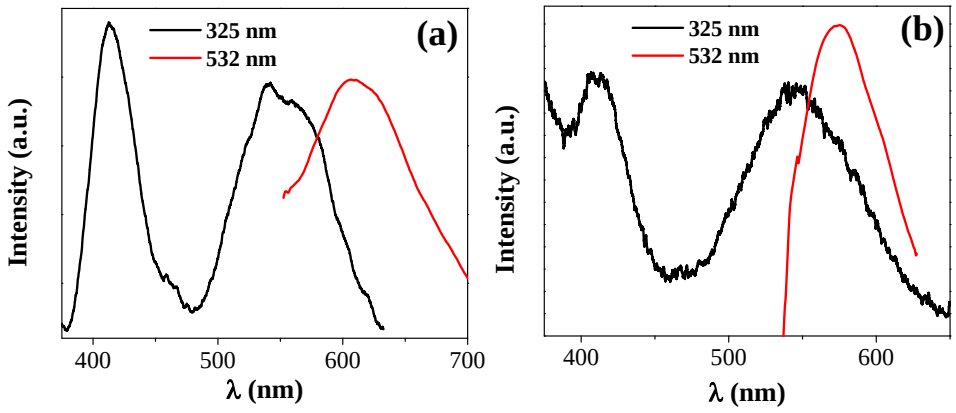

Figure S1. Optical images of PL emission at different excitations light from Ge/GeO_2 wafer and microcrystallites. PL spectra of (a) wafer, (b) microcrystallites with 325 and 532 nm of excitation.

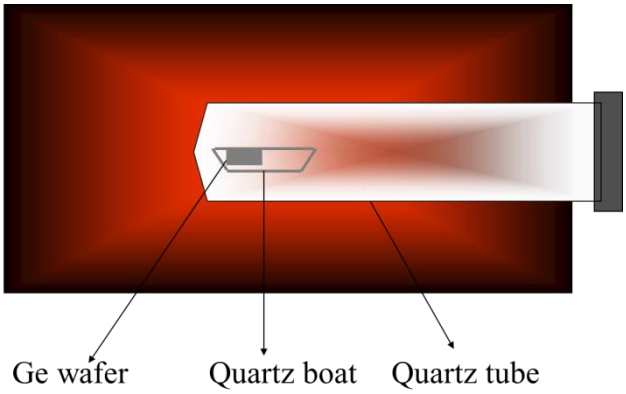

Figure S2. Schematic of the experimental setup used for the synthesis of Ge/GeO_2 holes.

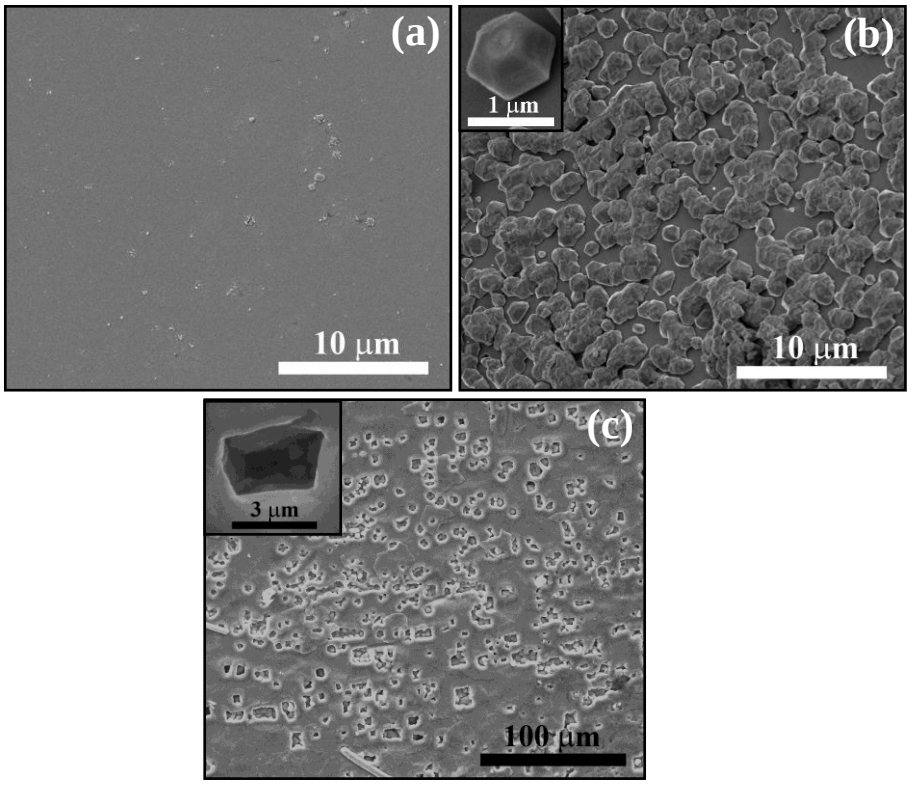

Figure S3. SEM images of Ge a) wafer and b) microcrystallites. Inset of (b) shows the magnified image of single microcrystal. (c) Ge wafer heated at 600 ^{o}C for 12 h (inset shows the magnified image of single hole).

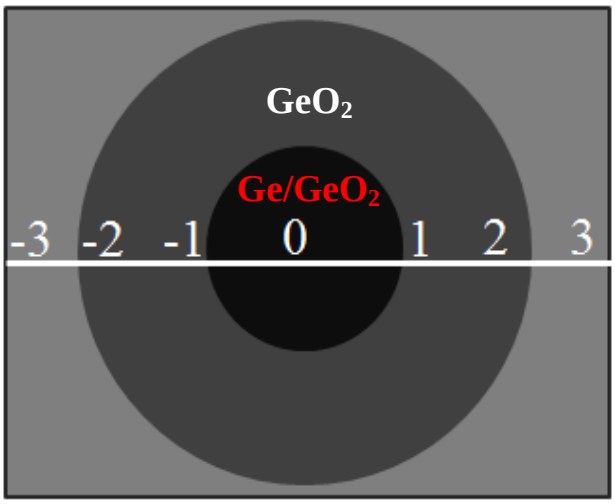

Figure S4. Schematic of single hole showing the position where EDX, Raman and PL have been taken. The distance between two consecutive positions is ~ 0.5 μm.

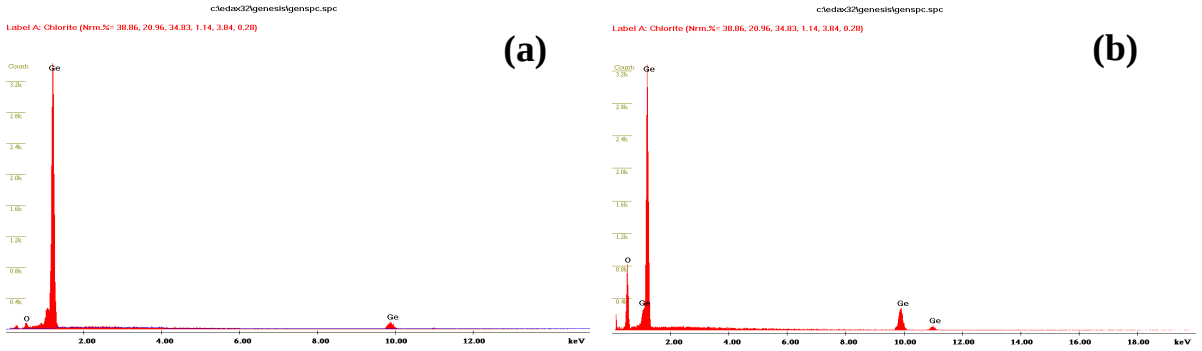

Figure S5. EDS of Ge/GeO_2 wafer taken at, a) inside the hole b) outside the hole.

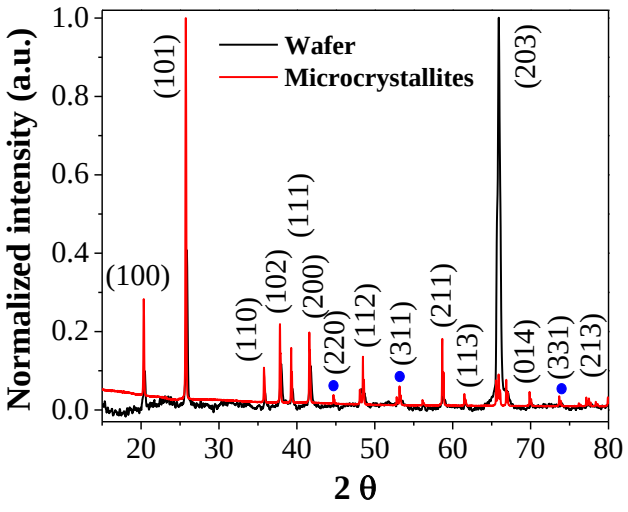

Figure S6. XRD of Ge/GeO_2 wafer and microcrystallites. The Ge phase peaks are shown in solid circle.

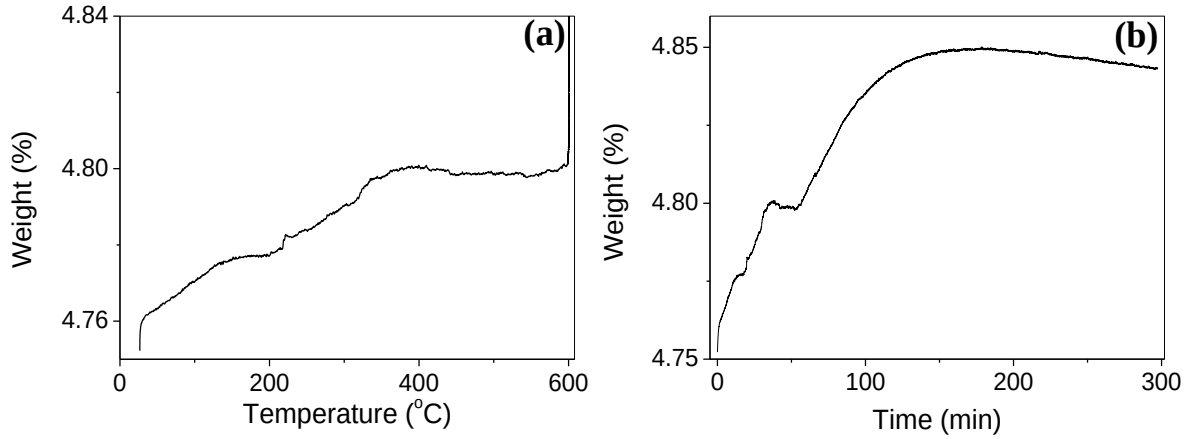

Figure S7. Oxidation kinetics curves of Ge wafer oxidized in air ambient at 600 °C for 4 h. (a & b) Variation of weight % with temperature and time, respectively.

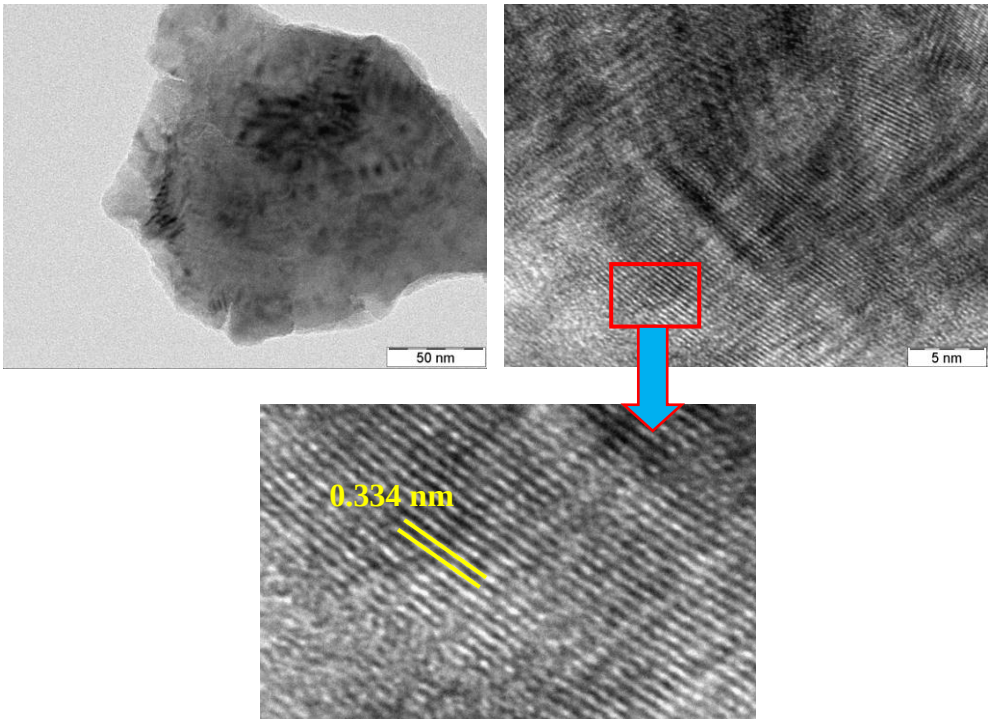

Figure S8. TEM/HRTEM images of portion of GeO_2 microcrystal.

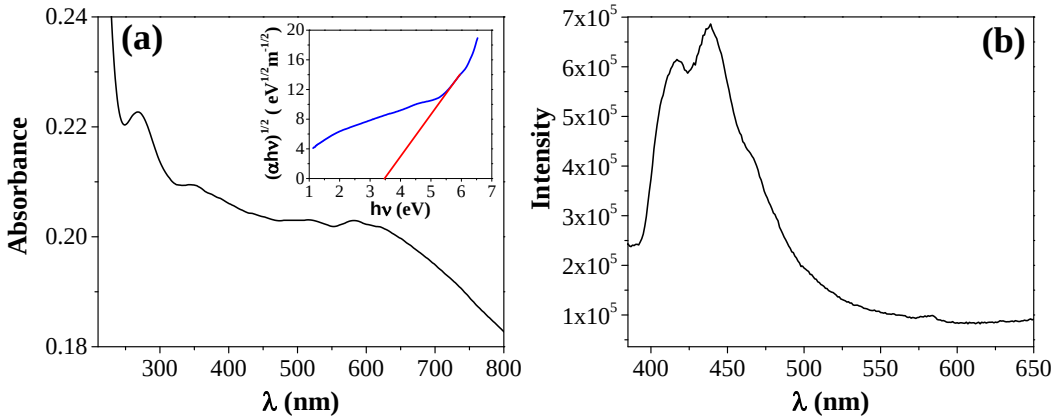

Figure S9. (a & b) Absorbance and luminescence spectra of GeO_2 microcrystallites, respectively. The excitation wavelength is 355 nm for luminescence spectra. It may be noted that the microcrystallites as shown in Fig. 6(a) has been ball-milled to obtain fine powders and absorbance and PL studies have been carried out in water solvent. Inset of (a) shows the Tauc plot for indirect band GeO_2 (3.48 eV).

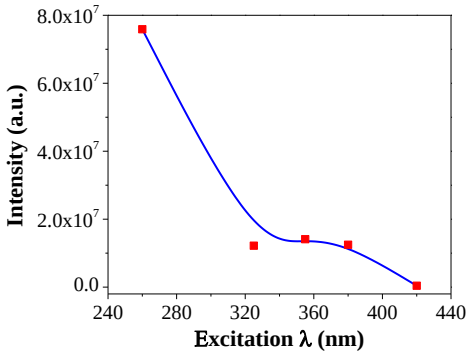

Figure S10. PL excitation spectra of Ge/GeO_2 wafer. The detection wavelength is 442 nm.

Table S1. Excitation dependent emission from GeO_2.

References No.	Morphology	Excitation	Emission
8	Ge/GeO_2 core/shell nanoparticles	325 nm	400 nm
9	GeO_2 nanocrystals	325 nm	410 nm
		441 nm	620 nm
10	Ge/GeO_2 nanoparticles	325 nm	410 nm 560 nm
11	GeO_2 nanowires	221 nm	485 nm
	GeO_2 bulk powder	221 nm	340 nm
		234 nm	345 nm
		325 nm	420 nm
12	GeO_2 nanowire	221 nm	347 nm
			364 nm
		305 nm	403 nm
			490 nm
13	GeO_2 nanowire network	265 nm	404 nm
14	Oxidized Germanium	488 nm	560 nm
15	hollow GeO_2 walnuts	325 nm	452 nm, 538 nm
	solid walnut		569 nm

Table S2. EDX analyses.

Elem.	Wt %	At %
O K	3.42	13.84
GeK	96.58	86.16
Total	100.00	100.00

Elem.	Wt %	At %
O K	40.05	75.19
GeK	59.95	24.81
Total	100.00	100.00