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High-yield, high-throughput synthesis of germanium nanowires by metal-organic chemical vapor deposition and their functionalization and applications

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Supplementary Information

Table S1 Summary of the parameters and results of Ge nanowire synthesis in this study.

Reaction temperature (℃)	DPG Concentration (M)	Flow rate (ml/min)	Injected Ge (mg)	Output Ge (mg)	Yield (%)
300	0.3	0.03	108.9	1.9	1.75
330	0.3	0.03	108.9	8	7.35
390	0.3	0.03	108.9	14	12.86
420	0.3	0.03	108.9	21.3	19.56
450	0.3	0.03	108.9	27	24.79
480	0.3	0.03	108.9	32.5	29.84
510	0.3	0.03	108.9	34.3	31.5
540	0.3	0.03	108.9	38.5	35.35
570	0.3	0.03	108.9	50	45.91

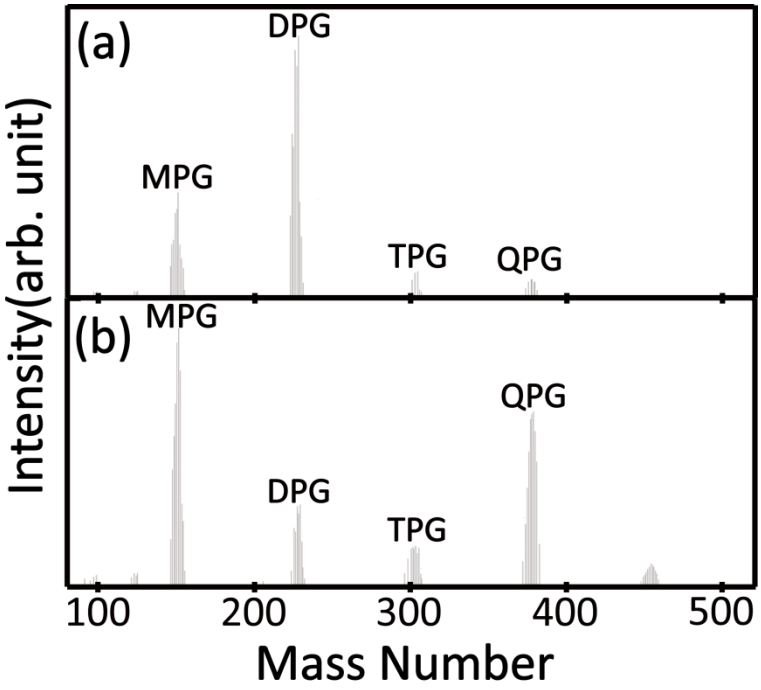

Fig. S1 GC-MS spectra of (a) DPG as received from Gelest. (b) Unreacted reactants exhausted from a DPG decomposition reaction in toluene at 480℃ showing that heavier phenylgermanes increased. Peaks are labeled that correspond to phenylgermane (MPG), diphenylgermane (DPG), triphenylgermane (TPG) and tetraphenylgermane (QPG). It should be noted that Ge oligomers might form due to molecular rearrangement in the ionizer during analysis

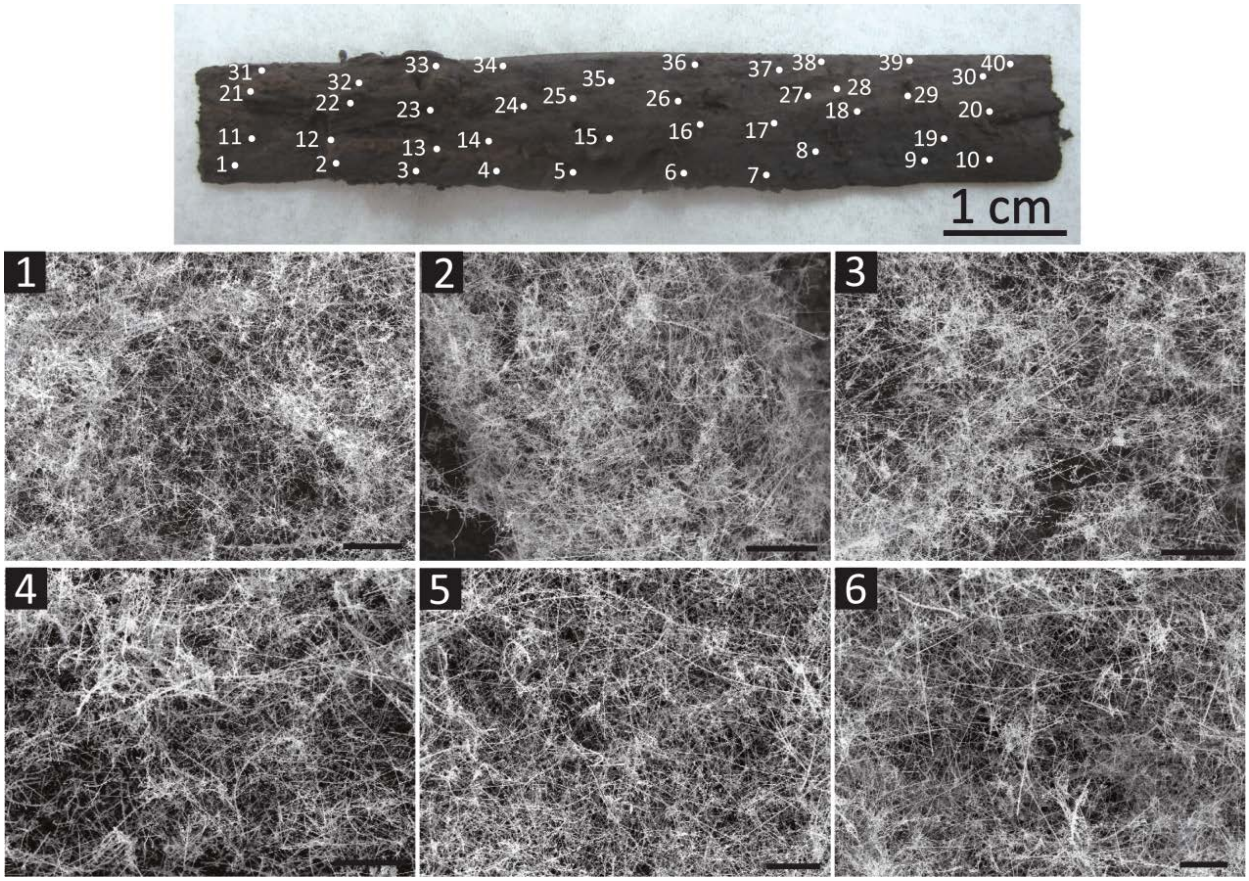

Fig. S2-1 Photograph of Ge nanowires on silicon substrate and marked out 40 points randomly-picked regions and SEM image of LICVD-grown Ge NWs synthesized from DPG with three-times injection of 40 different randomly-picked regions. Six regions of the 40 points randomly-picked SEM image, corresponds to the region 1 to the region 6. Scale bar, 50 μm.

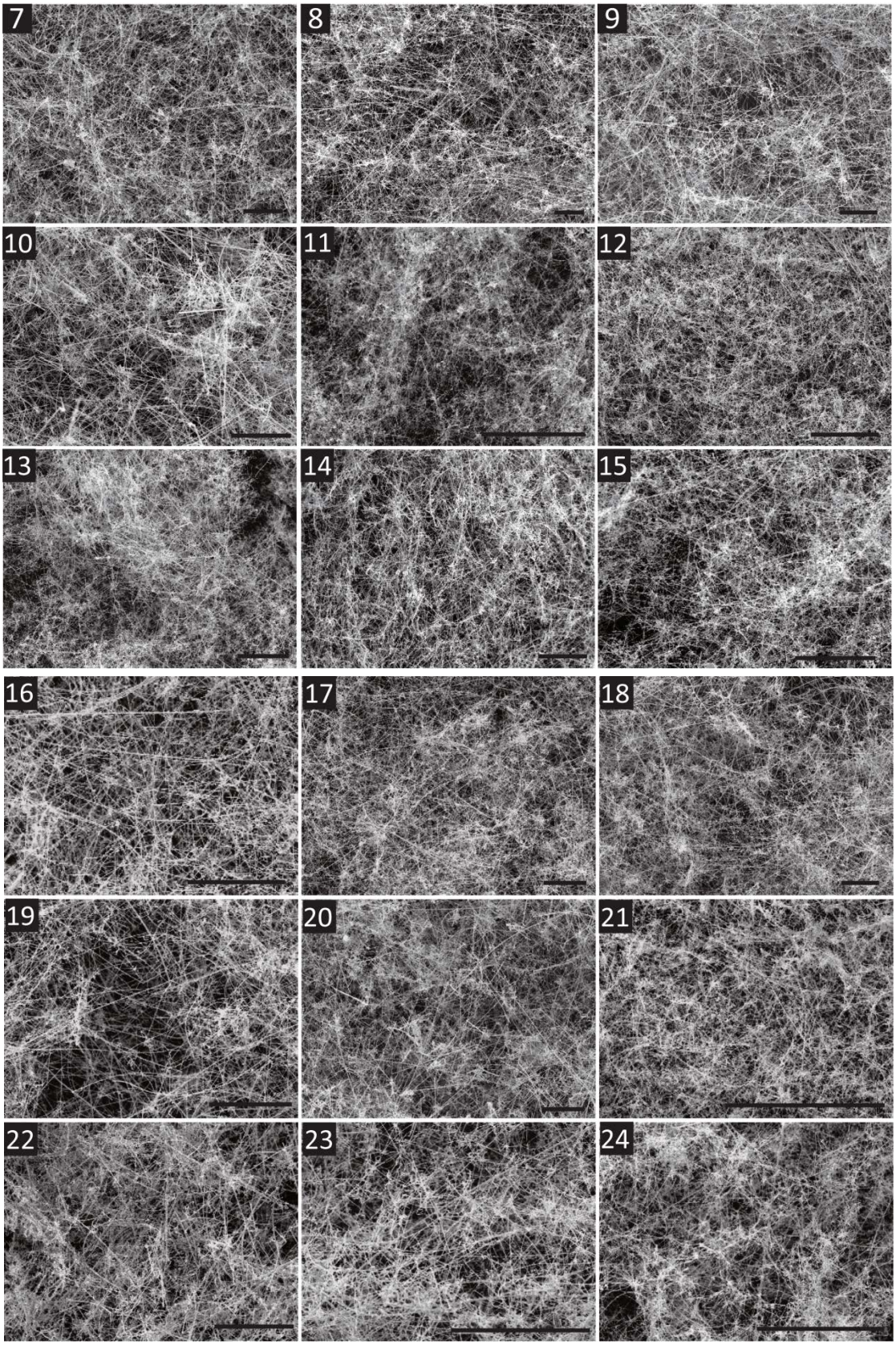

Fig. S2-2 SEM images of the region 7 to the region 24. Scale bar, 50 μm.

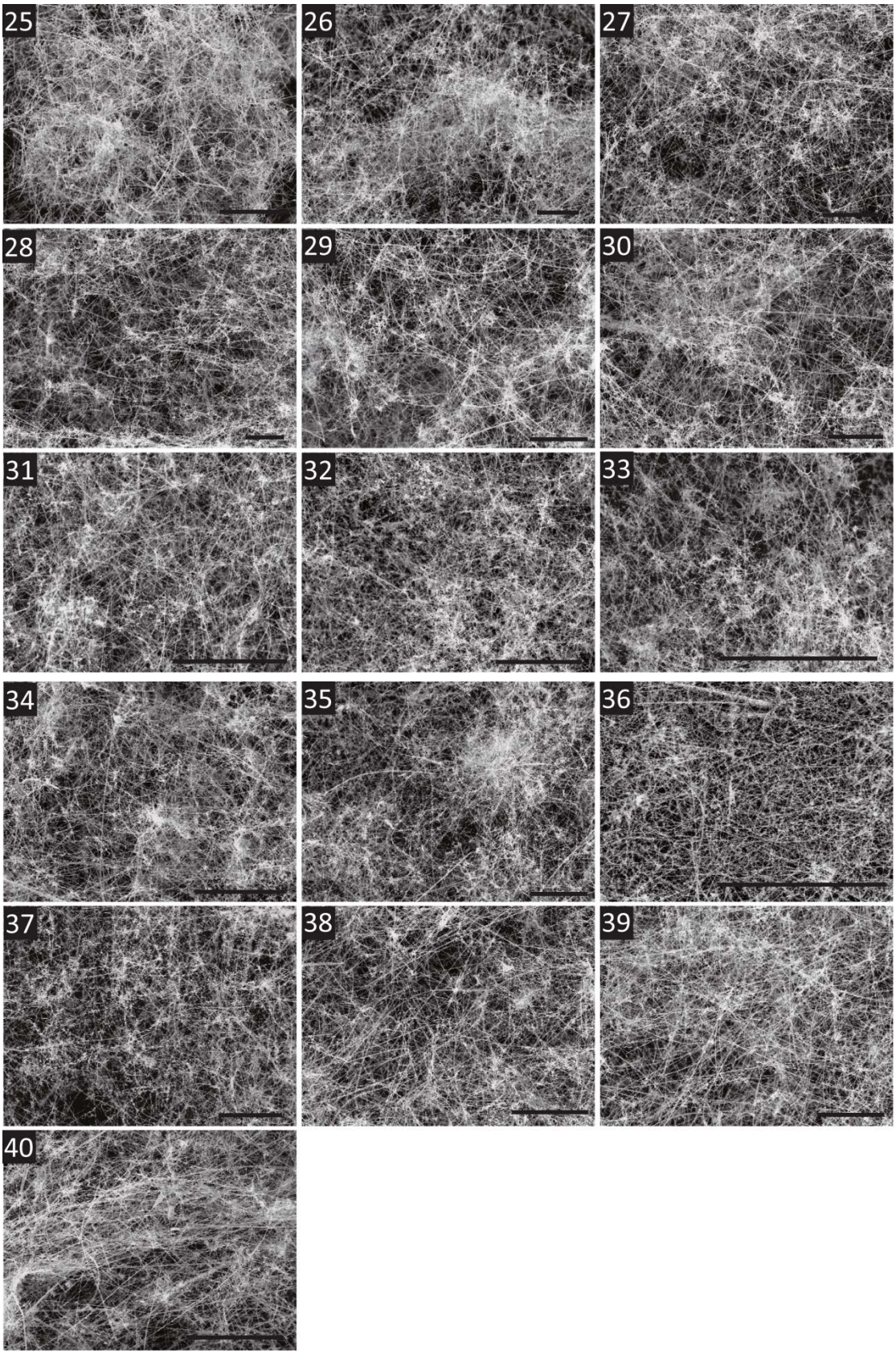

Fig. S2-3 SEM images of the region 25 to the region 40. Scale bar, 50 μm.