

# **Supporting information for: Thermally-Induced Dehydrogenative Coupling of Organosilanes and H-terminated Silicon Quantum Dots onto Germanane Surfaces**

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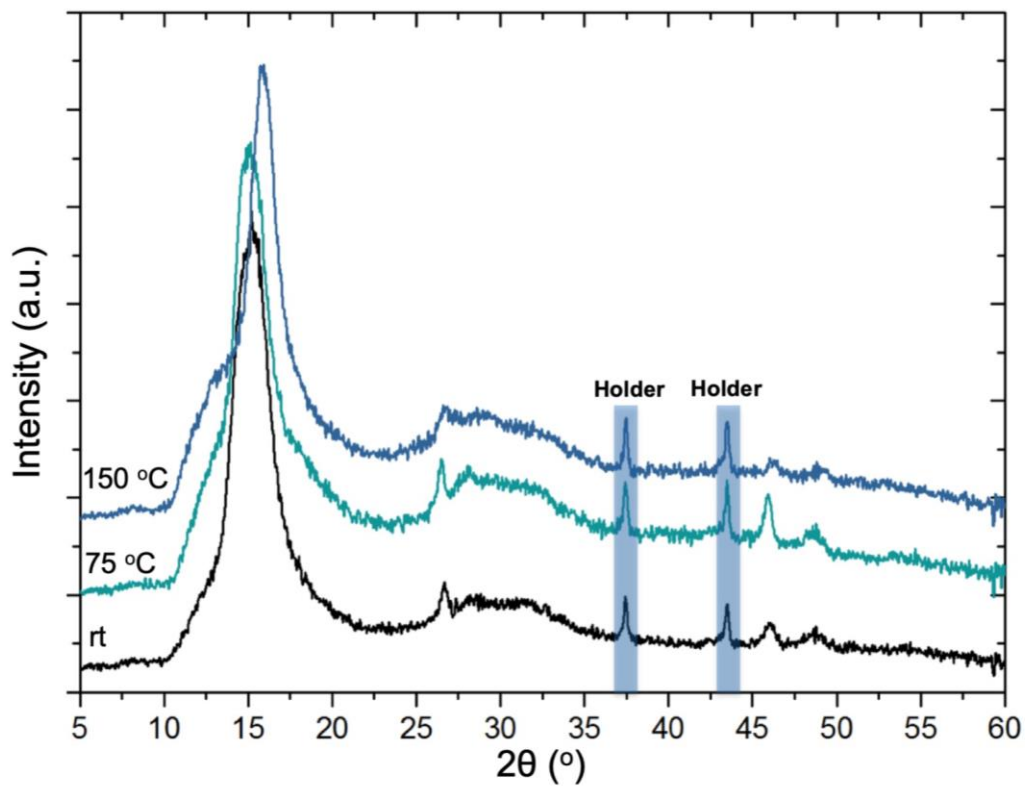
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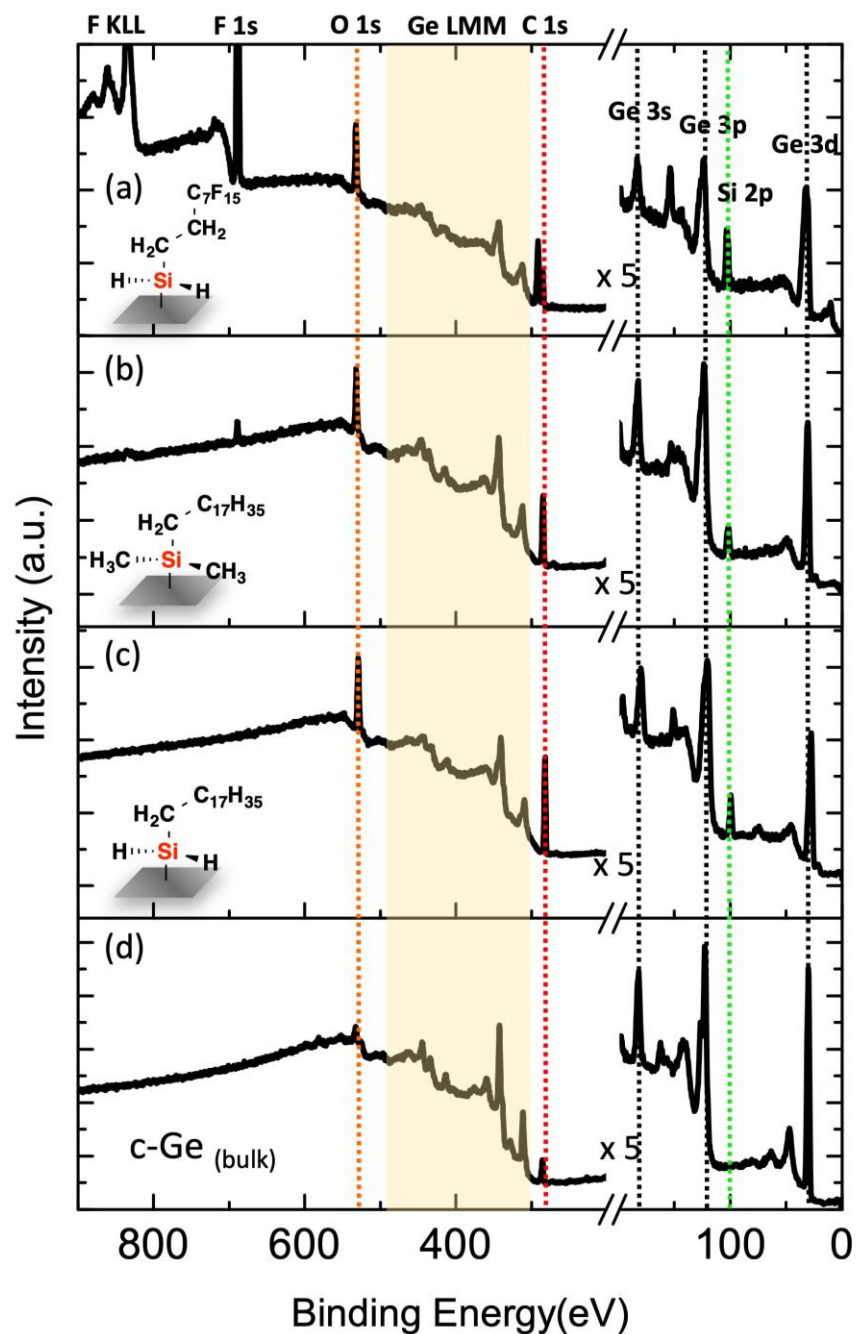
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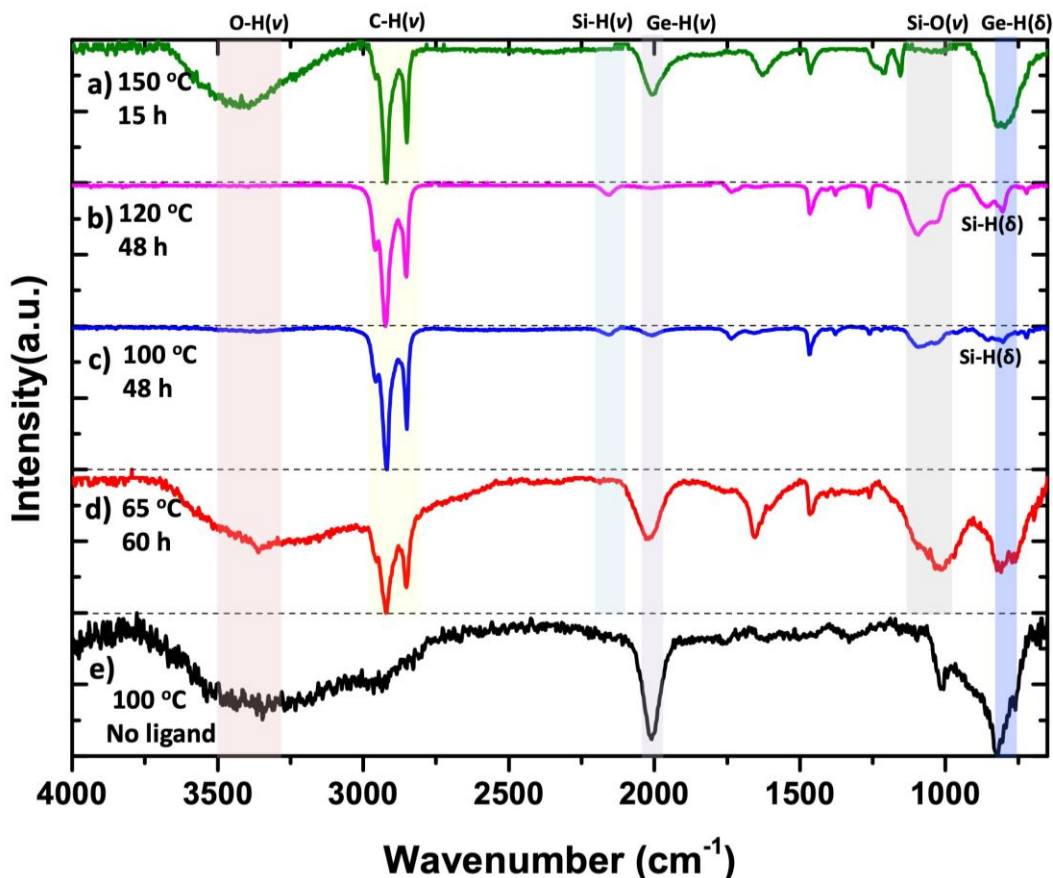
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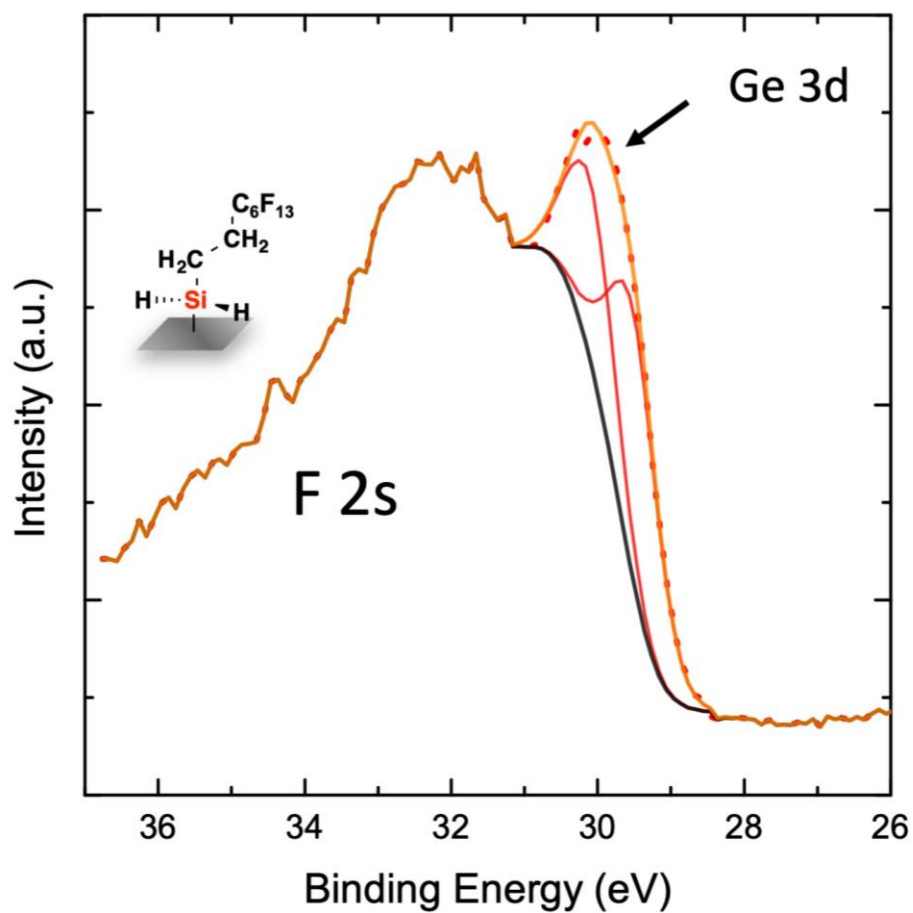
**Figure S1.** Powder X-ray diffraction of H-Ge flakes after thermal annealing.



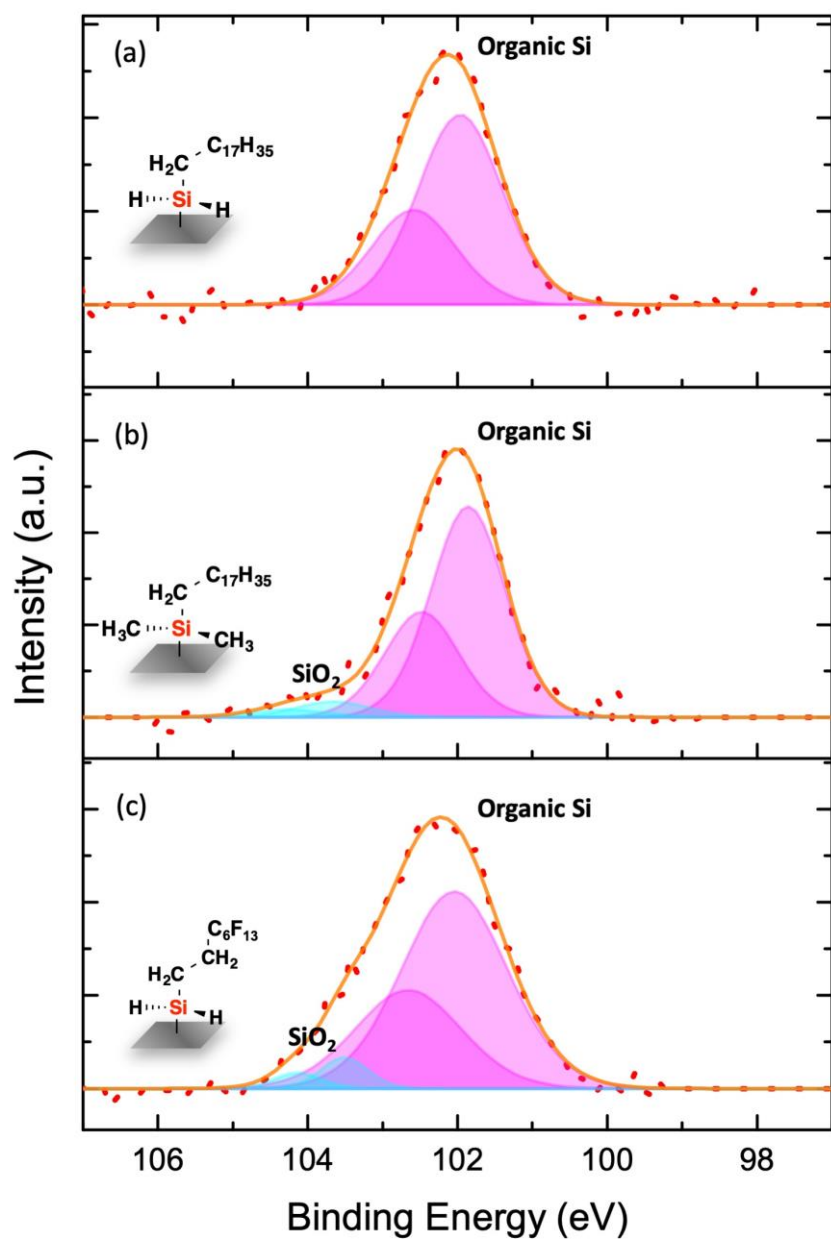
**Figure S2.** Survey X-ray photoelectron spectra of (a-c) organosilane functionalized GeNSs and (d) clean Ge (111) wafer; the silanes are (a) (tridecafluoro-1,1,2,2- tetrahydrooctyl)silane, (b) dimethyloctadecylsilane and (c) octadecylsilane.



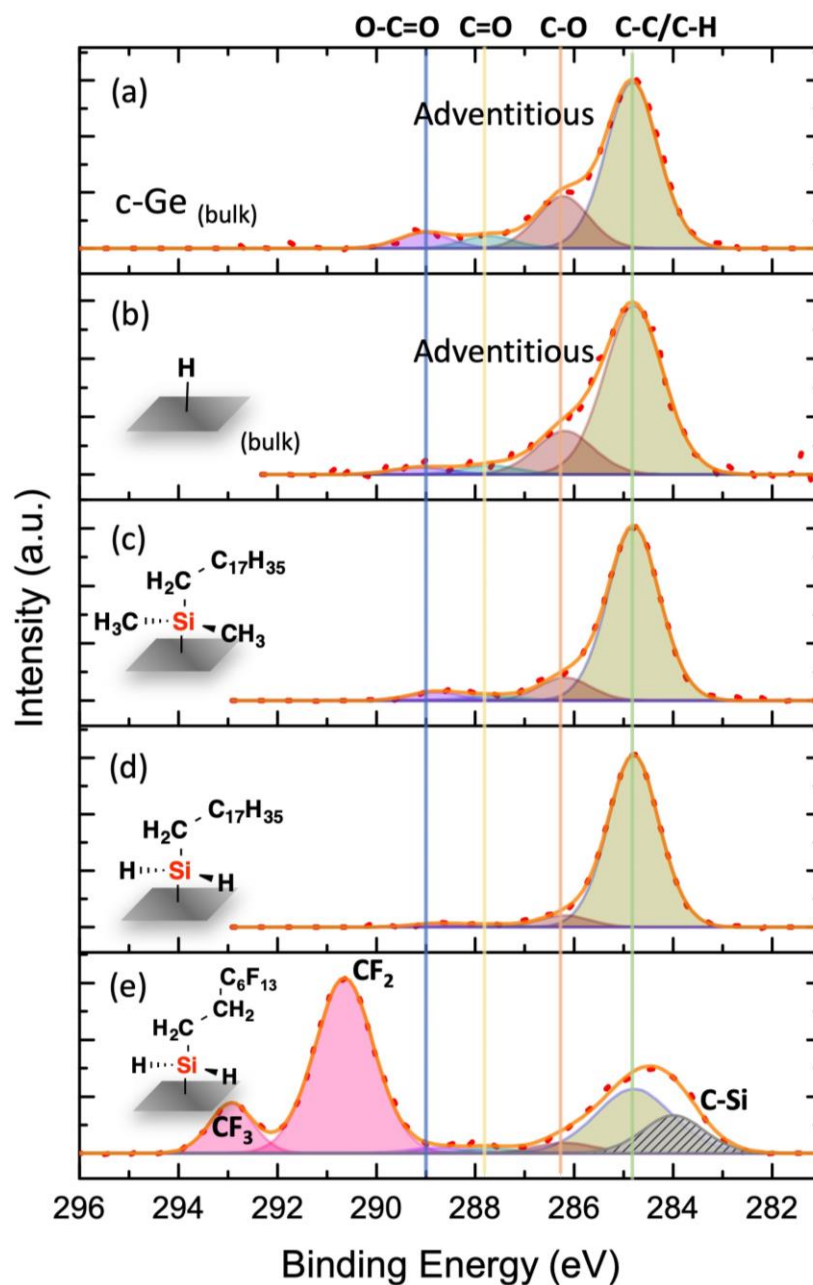
**Figure S3.** FTIR spectra of products obtained from indicated reaction conditions between octadecylsilane and germanane nanosheets. Products of reactions performed at 100 °C or 120 °C (blue and magenta traces, respectively) show a diminished Ge-H feature (ca. 2000  $\text{cm}^{-1}$ ) was greatly diminished consistent with effective surface functionalization after 48h. Reaction products obtained from higher reaction temperatures and shorter reaction times (150 °C, 15 hours; green trace) did not provide effective functionalization as evidenced by the presence of features arising from oxygen containing species. Reactions performed at lower temperatures for longer times (i.e., 65 °C, 60 hours; red trace) provide materials exhibiting intense Si-O-Si stretching and Ge-H features consistent with a mixture of oxidized silanes with non-functionalized GeH NSs.



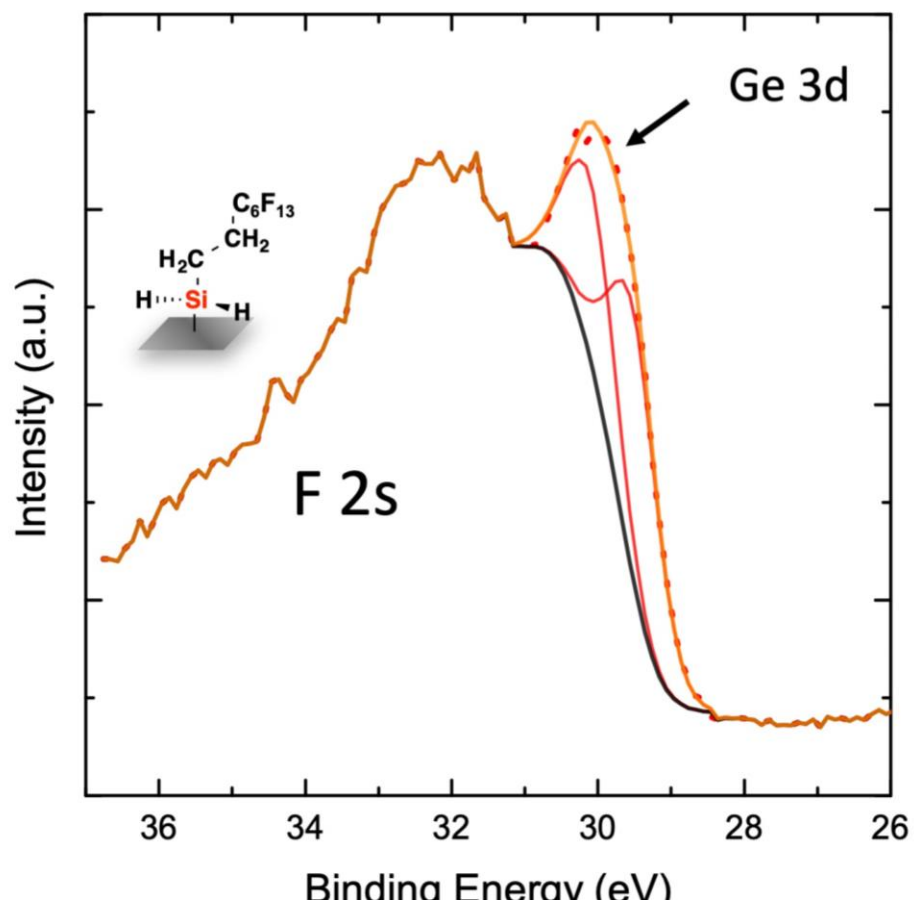
**Figure S4.** High-resolution XP spectrum of Ge 3d region of (tridecafluoro-1,1,2,2-tetrahydrooctyl) silane-terminated GeNSs. The Ge 3d and F 2s emissions overlap preventing detailed analysis.



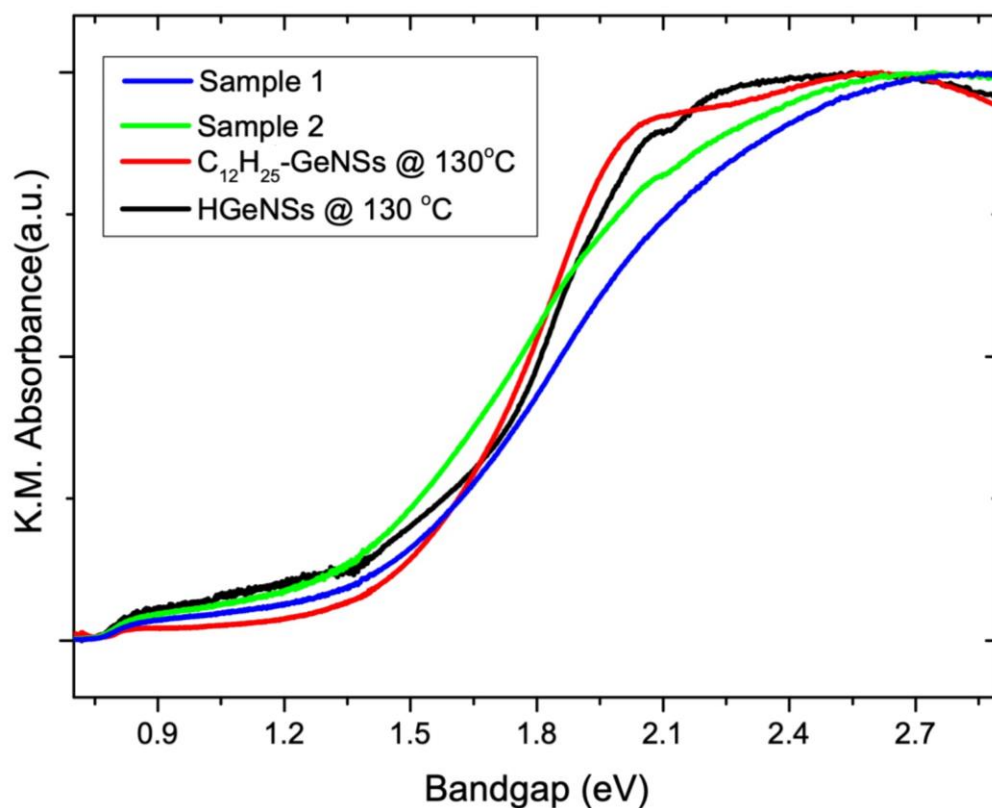
**Figure S5.** High resolution XPS spectra of Si 2p region organosilane functionalized GeNSs, the silanes are (a) octadecylsilane, (b) dimethyloctadecylsilane and (c) (tridecafluoro-1,1,2,2-tetrahydrooctyl)silane.



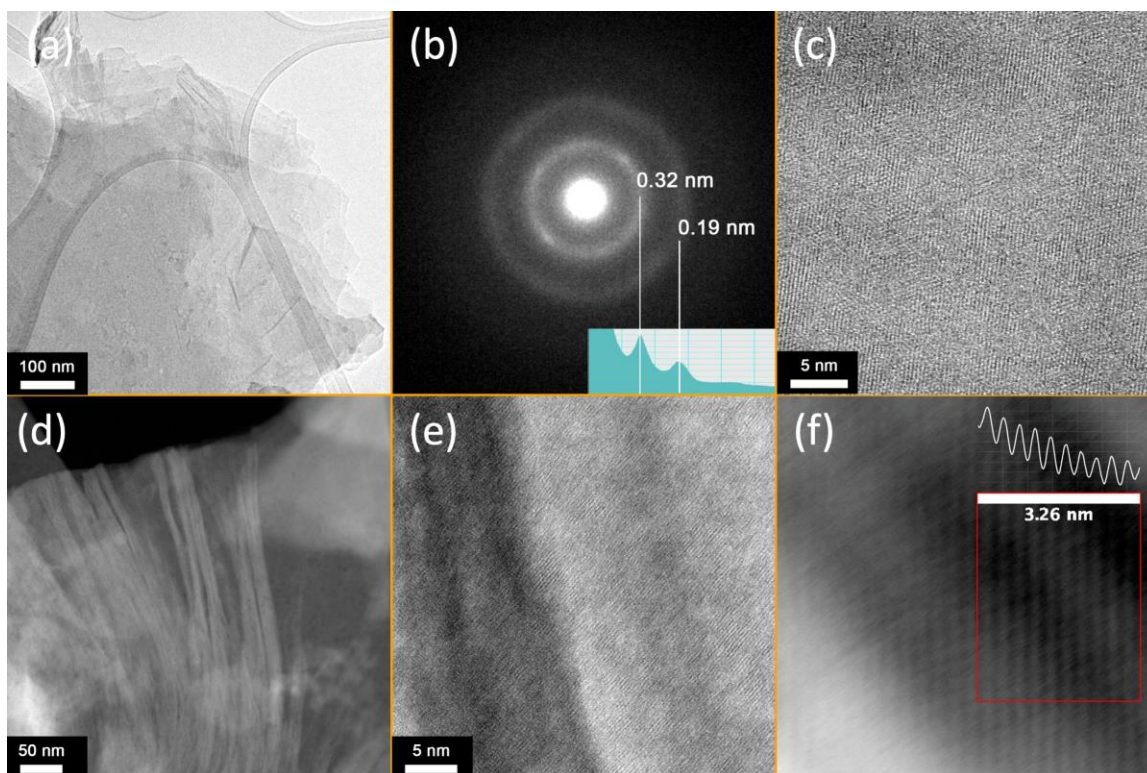
**Figure S6.** High resolution XPS spectra of C1s regions of (a) clean Ge (111) wafer (b) H-Ge flakes, (c-e) organosilane functionalized GeNSs, the silanes are (c) octadecylsilane, (d) dimethyloctadecylsilane and (e) (tridecafluoro-1,1,2,2-tetrahydrooctyl)silane, (a) and (b) were used to evaluate adventitious carbon level.



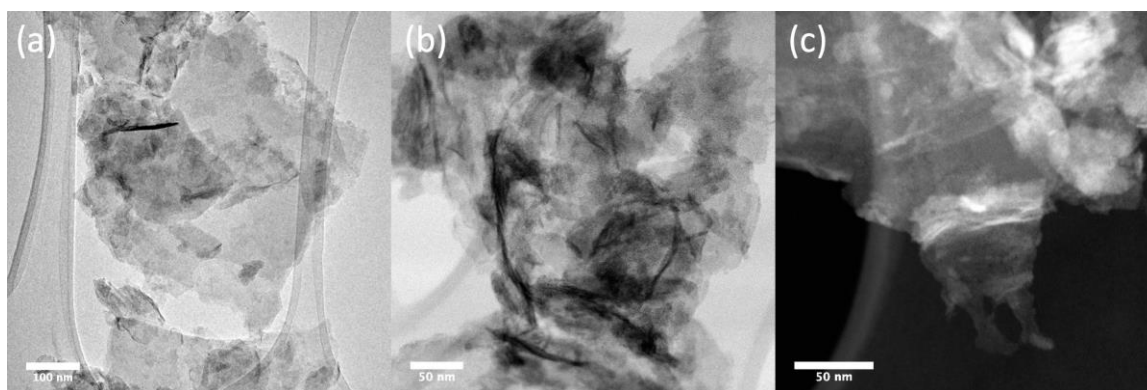
**Figure S7.** High resolution XPS spectrum of F 1s region of (tridecafluoro-1,1,2,2-tetrahydrooctyl) silane-terminated GeNSs



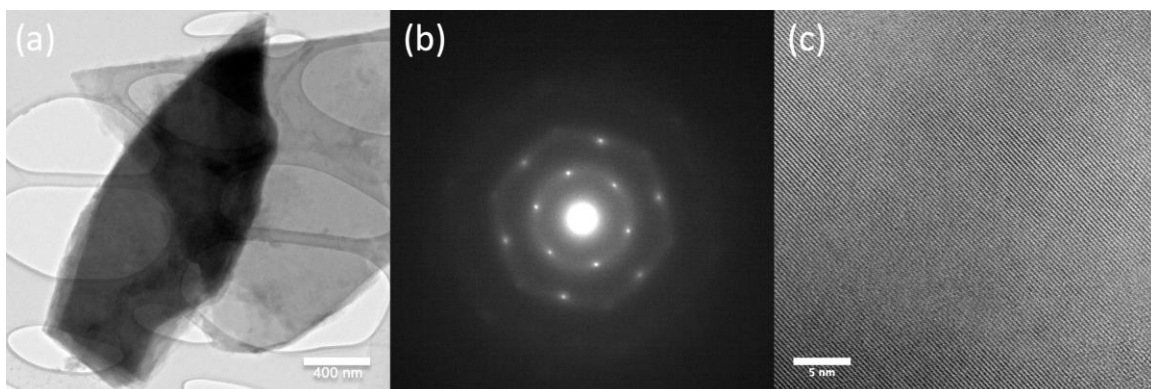
**Figure S8.** Diffuse reflectance spectra for **(blue)** Sample 1: H-GeNSs reacted with H-SiQDs at 80 °C and dodecyl-functionalized at 130 °C, **(green)** Sample 2: H-GeNSs reacted with H-SiQDs at 70 °C and dodecyl-functionalized at 130 °C, **(red)** dodecyl-functionalized GeNSs at 130 °C, and **(black)** H-GeNSs heated at 130 °C.



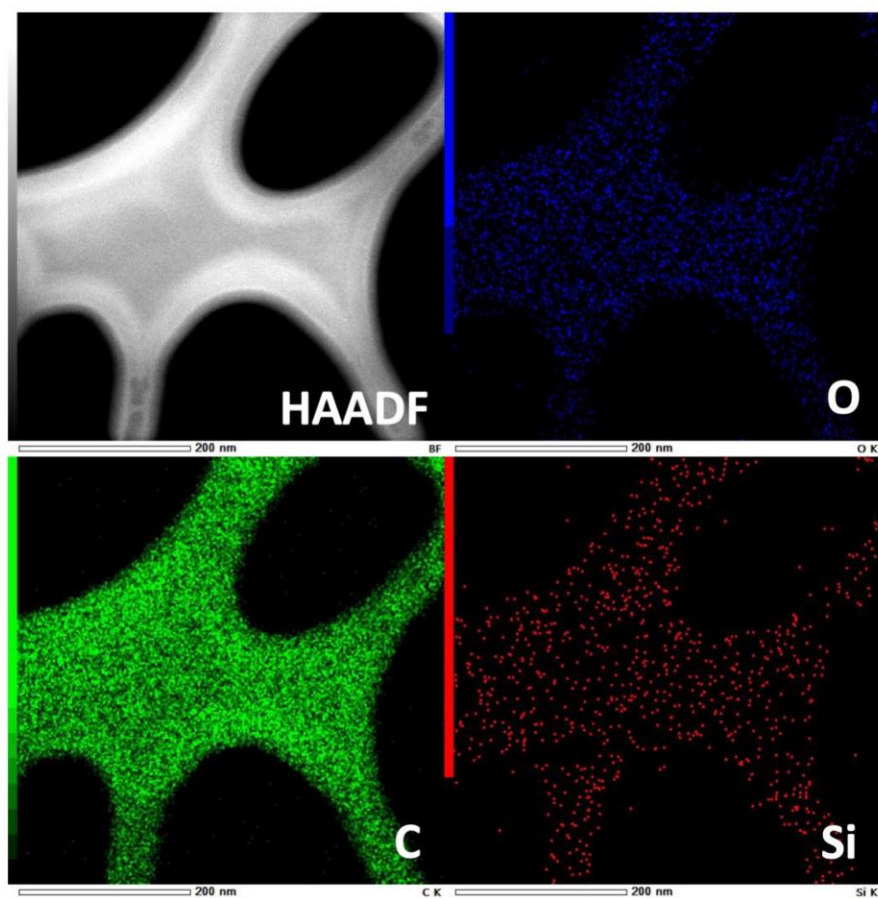
**Figure S9.** (S)TEM images of trioctylsilane-functionalized GeNSs, (a) bright-field low magnification, (b) SAED pattern at low-magnification (inset: radially integrated signal), (c) higher magnification, and (d-f) dark-field scanning images.



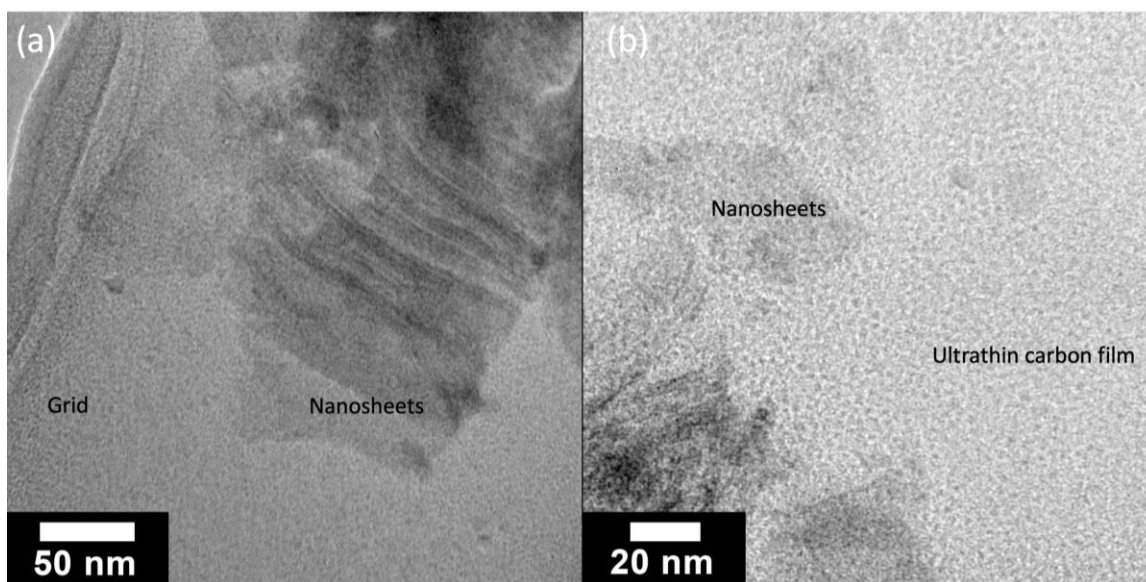
**Figure S10.** (a, b) bright-field TEM images and (c) dark-field STEM image of (tridecafluoro-1,1,2,2,-tetrahydrooctyl)silane-functionalized GeNSs.



**Figure S11.** (a) Bright-field TEM image, (b) SAED pattern and (c) high-magnification TEM image of monolayer to few layer H-Ge nanosheets.



**Figure S12.** HAADF-STEM with elemental mapping of clean holey carbon grid.



**Figure S13.** Bright-field TEM images of physical mixture of SiQDs and GeNSs, SiQDs are dark dots observed on GeNSs as well as on (a) support grid and (b) ultrathin carbon film.