Supplemental Material

Photonic bandgap and light routing in self-assembled lattices of epitaxial Ge/Si microstructures

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1. Photonic band structure calculations

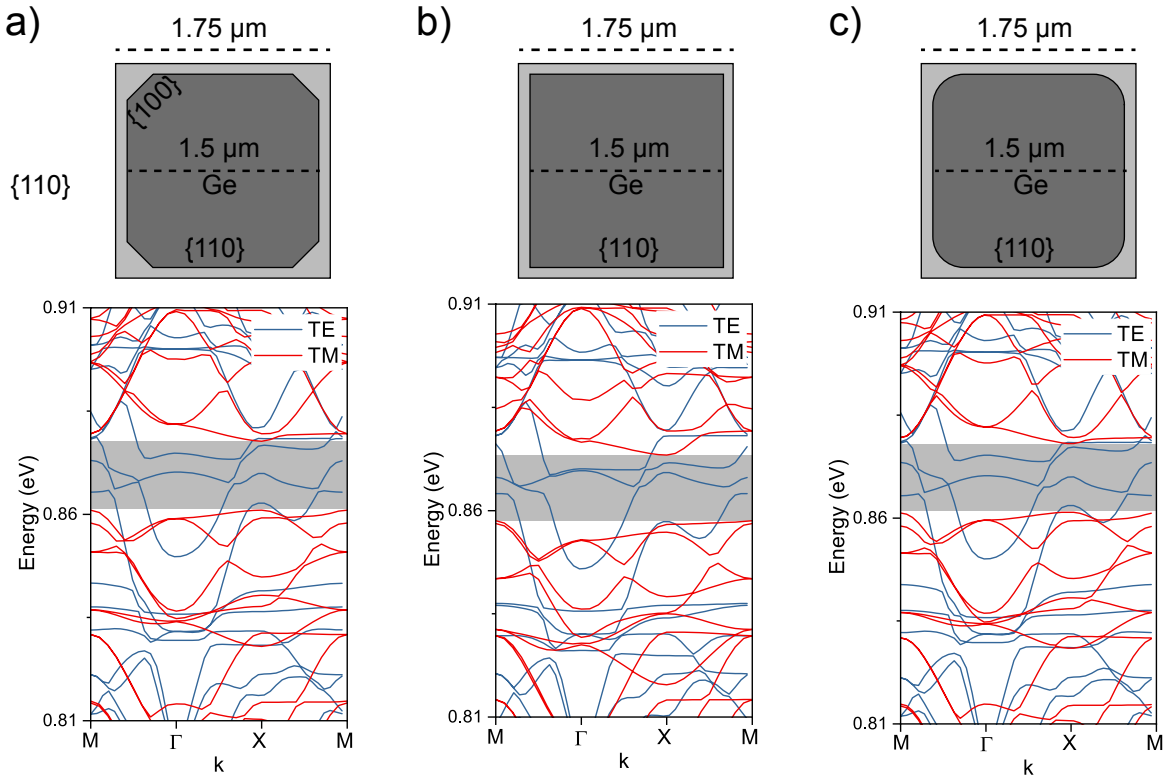

Figure S1: In-plane Photonic band structure for the TE (blue) and TM (red) polarizations. A photonic bandgap, highlighted by the grey area, can be observed for the TM but not for TE polarization. The band structure is calculated for different shapes of the microcrystal horizontal (in-plane) cross-section: a) corresponds to the one with {100} facets as described in the main text of the manuscript, b) a perfect square, and c) the shape studied in panel a) but with round edges. No major differences can be observed in the band structure of the three different geometries.

2. PL comparison of Ge microcrystals, unpatterned Ge film, and bulk Ge

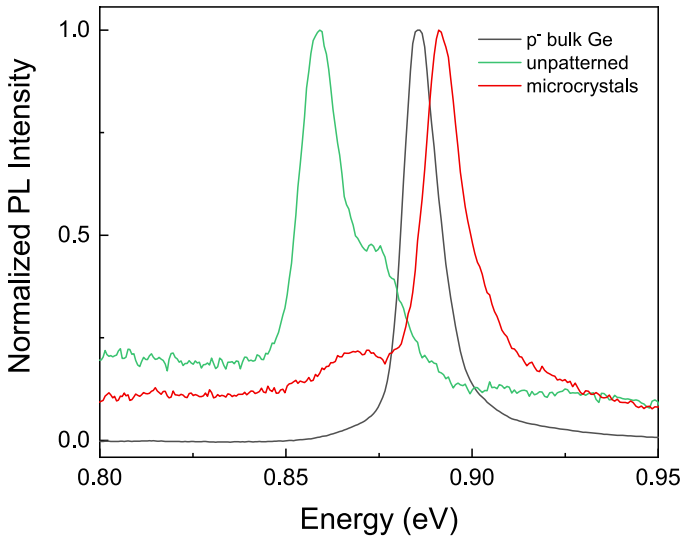

Figure S2: Normalized continuous wave photoluminescence spectra measured at 5 K in an 8 µm thick unpatterned Ge epilayer on Si (green line), in an 8 µm thick Ge microcrystals (red line), and in a slightly p-doped bulk Ge (black line) under 1064 nm excitation. The doping level of the bulk Ge sample is 2.2×10^{16} cm^{-3}. The difference in the energy of the PL between the unstrained microcrystals and the bulk has to be ascribed to the different doping level between the two samples. The difference is compatible with the expected not-intentional background doping level of the microcrystals ($<10^{15}$ cm^{-3}). The low-energy shoulder at 0.870 eV present in the microcrystals PL is absent in the bulk sample, allowing us to exclude the contribution of electronic Raman scattering.

3. Raw PL spectra

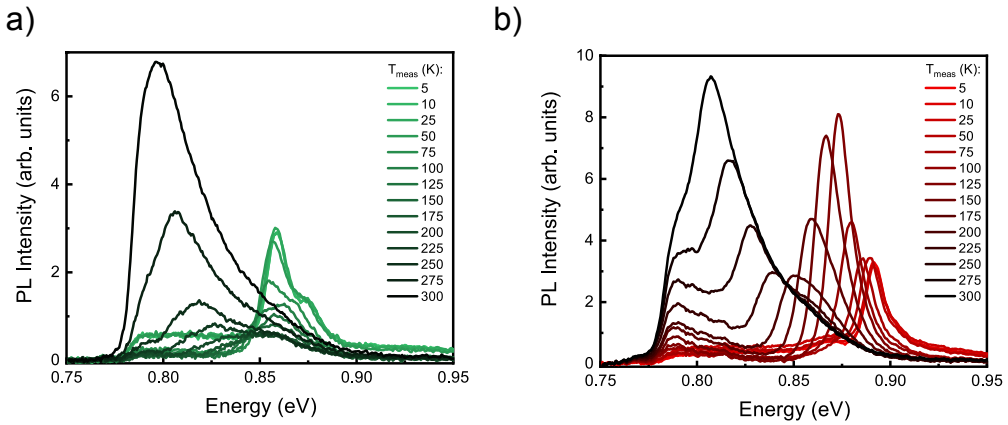

Figure S3: Continuous wave PL spectra as a function of the lattice temperature for a) the 8 µm thick flat Ge film and b) the 8 µm thick patterned Ge microcrystals, under 1064 nm excitation. The temperature rangesfrom 5 K to 300 K.

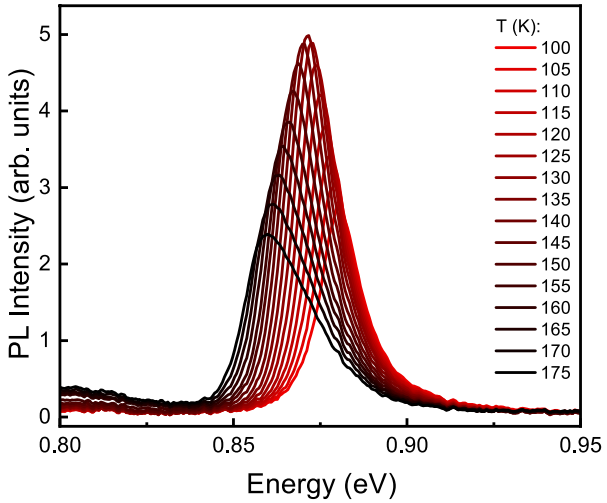

Figure S4: PL spectra of the 8 μm patterned Ge microcrystals in the temperature range (from 100 K to 175 K, every 5 K) around the critical temperature at which the PL intensity demonstrated its maximum value.

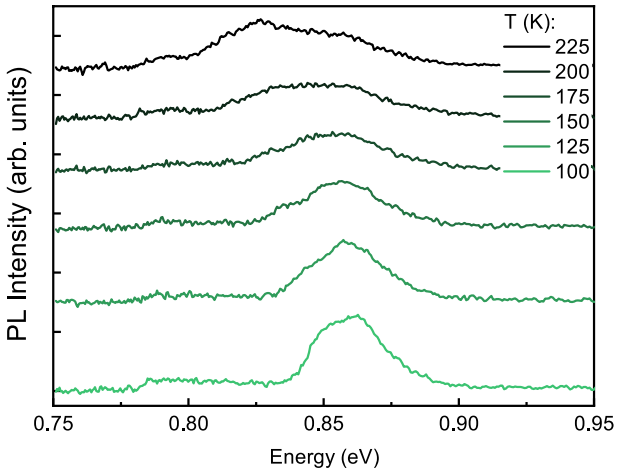

Figure S5: Selected PL spectra of the 8 μm thick Ge film in a temperature range (100 K – 225 K) where the HH and LH contributions are merged. The data are shifted vertically for clarity. In this temperature regime, the PL is broad and its components are not-well resolved.

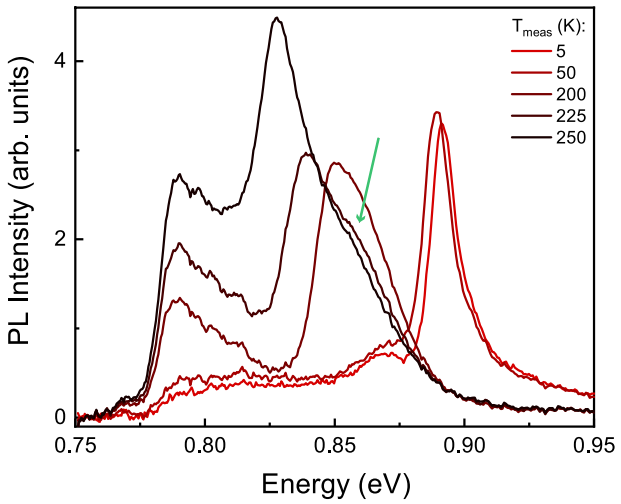

Figure S6: Selected PL spectra of the 8 μm patterned Ge microcrystals at different temperatures (5 K, 50 K, 200 K, 225 K, and 250 K) that suggest the presence of the minor PL contribution at about 0.87 eV also in this high T range (see for instance the green arrow).