Electronic Supplementary Material (ESI) for Nanoscale Horizons.

Supplementary Information

All-Around Encapsulation of Silicene

Daya S. Dhungana,[a†] Chiara Massetti,[a,b†] Christian Martella,[a*] Carlo Grazianetti[a*] and Alessandro Molle[a*]

[a]*CNR-IMM Agrate Brianza Unit, via C. Olivetti 2, Agrate Brianza, I-20864, Italy*

[b]*Dipartimento di Scienza dei Materiali, Universita' di Milano-Bicocca, Via Cozzi 53, Milano I- 20125, Italy*

Corresponding Authors: christian.martella@cnr.it, carlo.grazianetti@cnr.it, and alessandro.molle@cnr.it

† Equal Contribution

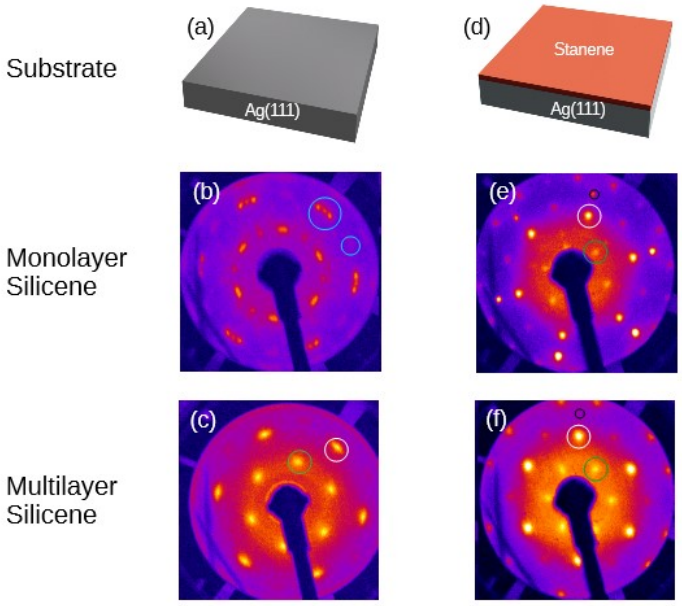

Figure S1. Low-energy electron diffraction (LEED) of single and multilayer silicene grown on Ag(111) and Sn-Ag(111). **(a)** sketch of the Ag(111) substrate. **(b)** LEED pattern where the blue marked spots are mixed silicene phases (4×4, √13×√13R 13.9˚ type I and type II) acquired at incident LEED energy 29 eV. **(c)** LEED pattern of the multilayer silicene sample (3 MLs) with √3×√3R30˚ termination and acquired at 29 eV. **(d)** sketch of the Sn-Ag(111) substrate. **(e)** LEED pattern of single layer silicene and **(f)** multilayer silicene as in (b) and (c) acquired at 53 eV.

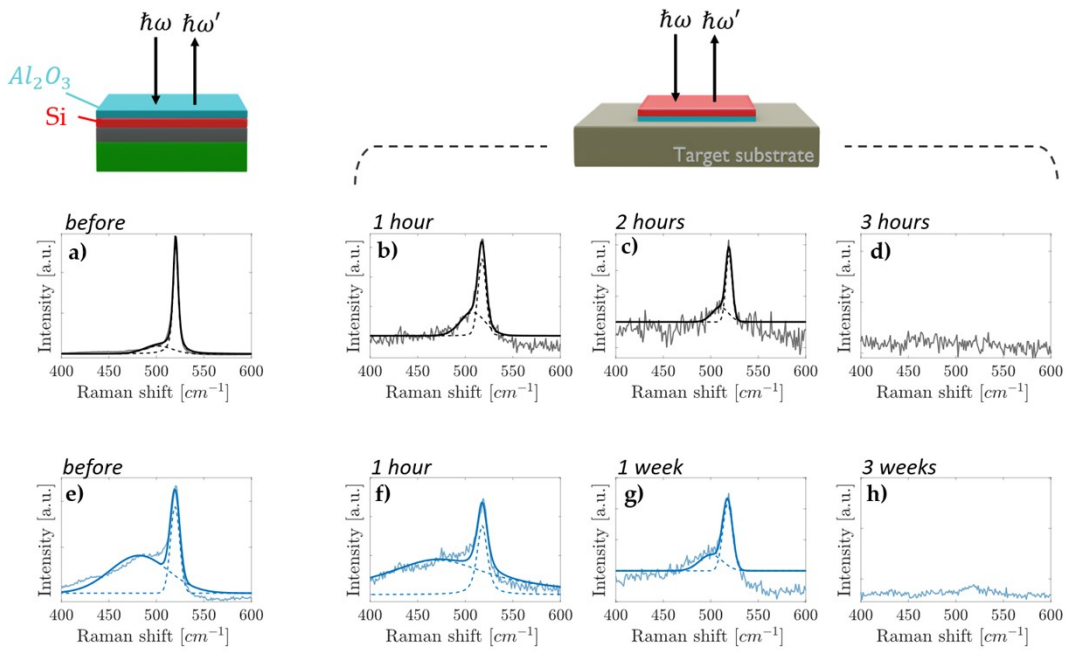

Figure S2. Raman spectroscopy characterization of Al_2O_3-capped single **(a-d)** and multilayer **(e-h)** silicene grown directly on Ag(111). **(a)** and **(e)** are the Raman spectra taken before processing (see Figure 1 of main text), while (**b-d**) and **(f-h)** are the Raman spectra acquired after the sample transfer and hence from the Ag-free etched region. In each plot the faint curve is the raw data, the dark curve is the corresponding fit result and the two dashed curves show the two components used in the fitting procedure.

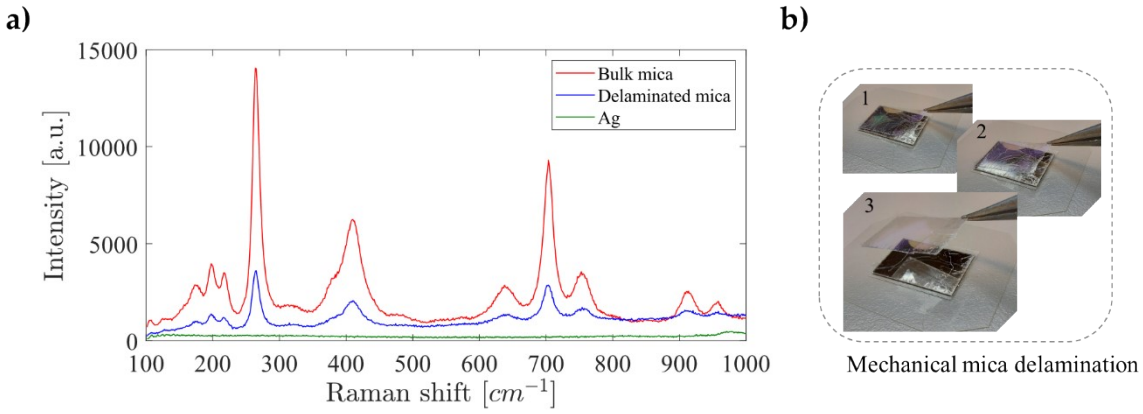

Figure S3. (a) Raman spectra acquired during mica delamination when the sample is transferred onto the targe substrate and the mica layers are then on top. The red line refers to the Raman spectrum acquired before the onset of delamination i.e., on bulk mica.[S1] The blue Raman spectrum relates to the acquisition after mechanical removal of mica substrate and after several peels with blue tape. The green line confirms that the mica residues have been completely removed, and therefore corresponds to the (Raman-silent) silver spectrum. **(b)** Pictures of the mechanical delamination process of mica at each process stage described above.

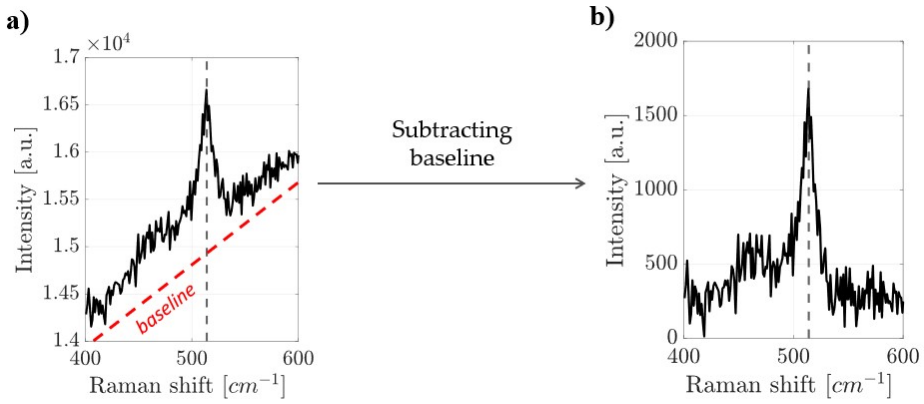

Figure S4. Linear baseline correction procedure performed in the case of the Raman spectra taken after sample transfer. **(a)** The background is related to the fluorescence of the glue through which the sample is attached to the target substrate. **(b)** Raman spectrum after the baseline correction. In all cases mentioned in the main text, any wavenumber variations are included within the uncertainty related to the peak position.

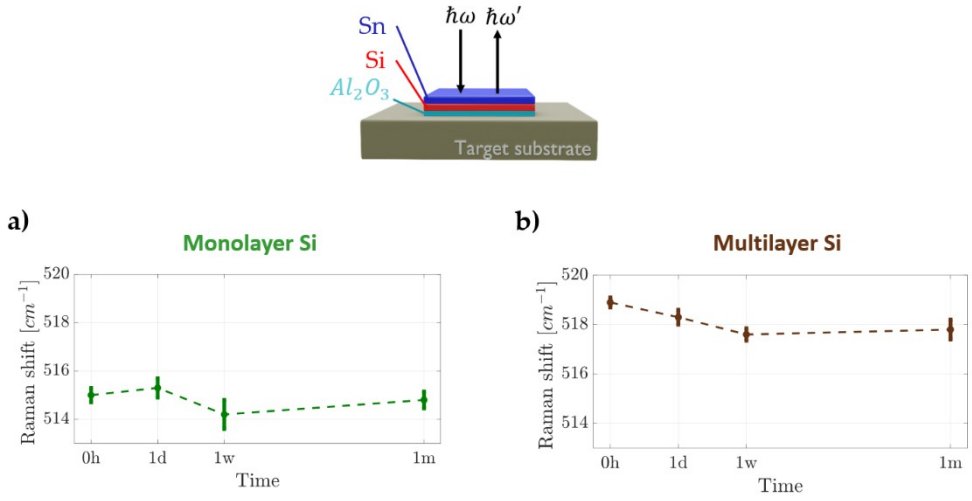

Figure S5. Raman spectroscopy characterization of single and multilayer silicene. Monitoring of the Raman peak position obtained by fitting the spectra in the case of single layer **(a)** and multilayer silicene **(b)** synthesized on Sn-Ag(111) template.

a)

Monolayer Si heterostructure	Peak 1 [cm^{-1}]	Peak 2 [cm^{-1}]	Intensities ratio (p2/p1)
before etching	515,0 ± 0,3	490 ± 1	~ 0,2
1 day	515,3 ± 0,4	488 ± 1	~ 0,3
1 week	514,2 ± 0,6	480 ± 2	~ 0,3
1 month	514,8 ± 0,3	492 ± 1	~ 0,3

b)

Multilayer Si heterostructure	Peak 1 [cm^{-1}]	Peak 2 [cm^{-1}]	Intensities ratio (p2/p1)
before etching	518,9 ± 0,2	486 ± 2	~ 0,2
1 day	518,3 ± 0,3	487 ± 1	~ 0,2
1 week	517,6 ± 0,3	480 ± 1	~ 0,3
1 month	517,8 ± 0,4	479 ± 2	~ 0,2

Table TS1. Fit results obtained for single **(a)** and multilayer **(b)** silicene heterostructures. The peaks position values (expressed as mean value ± standard deviation) and the intensities ratios are shown.

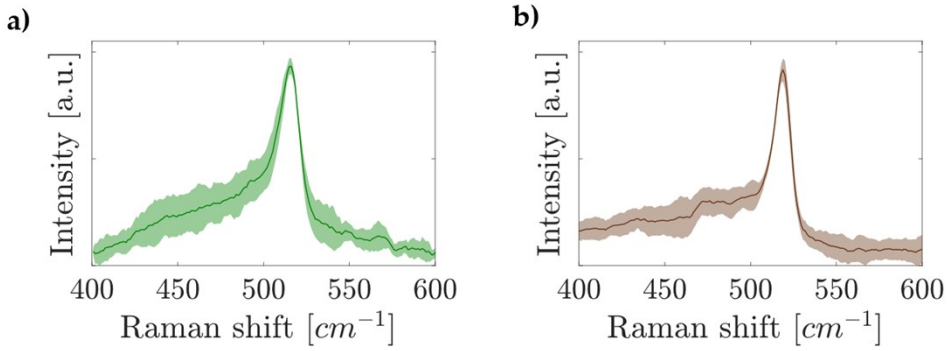

Figure S6. Mean spectra (solid lines) and standard deviations (shaded regions) for single **(a)** and multilayer **(b)** silicene heterostructures.

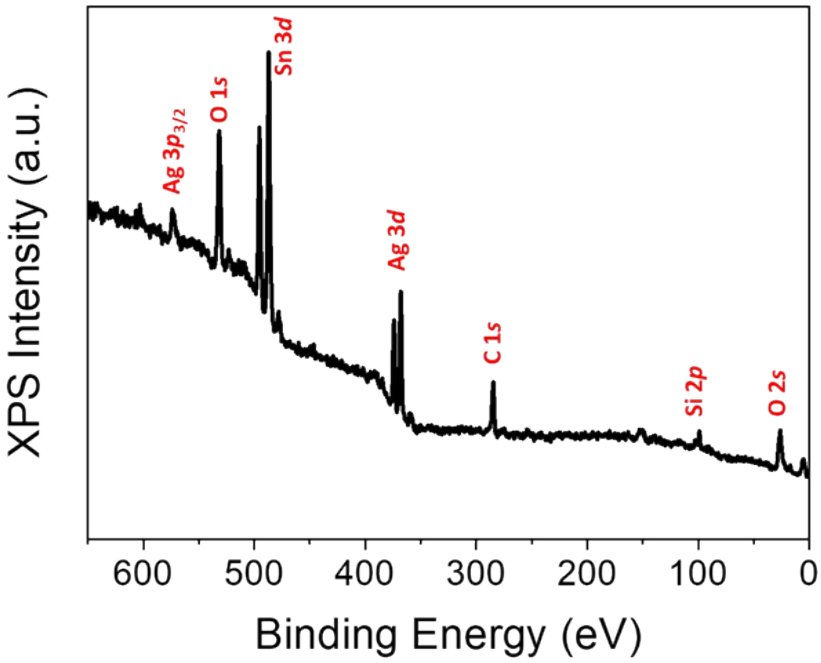

Figure S7. XPS survey spectrum of the Sn/silicene/stanene on Ag(111) configuration reported in Figure 3 of main text.

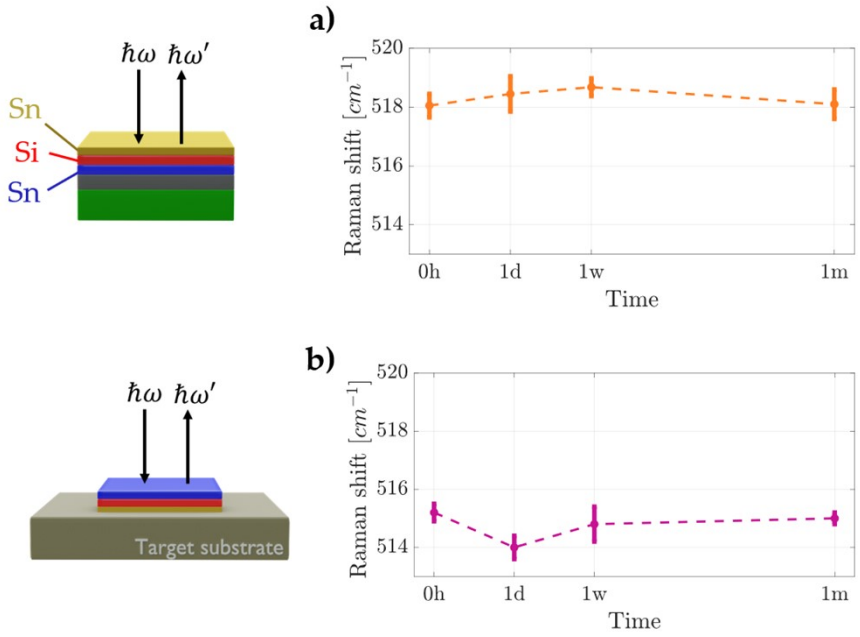

Figure S8. Monitoring of the Raman peak position obtained by fitting the spectra in the case of silicene sample protected by the Sn layer. **(a)** refers to the case of spectra acquired after the growth while **(b)** is related to the spectra acquired after the sample transfer, hence from the Ag-etched region.

a)

Sn-Si-Sn	Peak 1 [cm^{-1}]	Peak 2 [cm^{-1}]	Intensities ratio (p2/p1)
after growth	518,1 ± 0,4	490 ± 1	~ 0,1
1 day	518,5 ± 0,6	493 ± 1	~ 0,2
1 week	518,7 ± 0,3	491 ± 1	~ 0,2
1 month	518,1 ± 0,5	492 ± 1	~ 0,2

b)

Sn-Si-Sn	Peak 1 [cm^{-1}]	Peak 2 [cm^{-1}]	Intensities ratio (p2/p1)
after etching	515,2 ± 0,3	502 ± 2	~ 0,3
1 day	514,0 ± 0,4	503 ± 2	~ 0,3
1 week	514,8 ± 0,6	490 ± 2	~ 0,2
1 month	515,0 ± 0,2	486 ± 2	~ 0,3

Table TS2. Fit results obtained in the case of silicene sample protected by the Sn layer. **(a)** refers to the case of spectra acquired after the growth and **(b)** refers to the spectra acquired after the sample transfer. The peaks position values (expressed as mean value ± standard deviation) and the intensities ratios are shown.

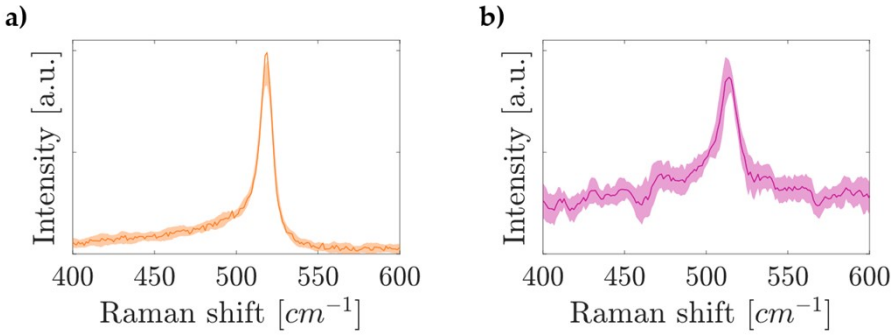

Figure S9. Mean spectra (solid lines) and standard deviations (shaded regions) for silicene sample protected by the Sn layer. **(a)** refers to the case of spectra acquired after the growth and **(b)** refers to the spectra acquired after the sample transfer. It should be noted that, due to the presence of glue, more significant deviations of Raman spectra occur in the case of the transferred sample after the Ag etching (violet) compared to characterization performed after the growth (orange).

References

S1 D. A. Mckeown, M. I. Bell, and E. S. Etz, American Mineralogist, 1999, **84**, 1041–1048.