Supplementary Information

Fabrication of Ag-perovskite substrates for surface-enhanced Raman scattering via all-vacuum deposition

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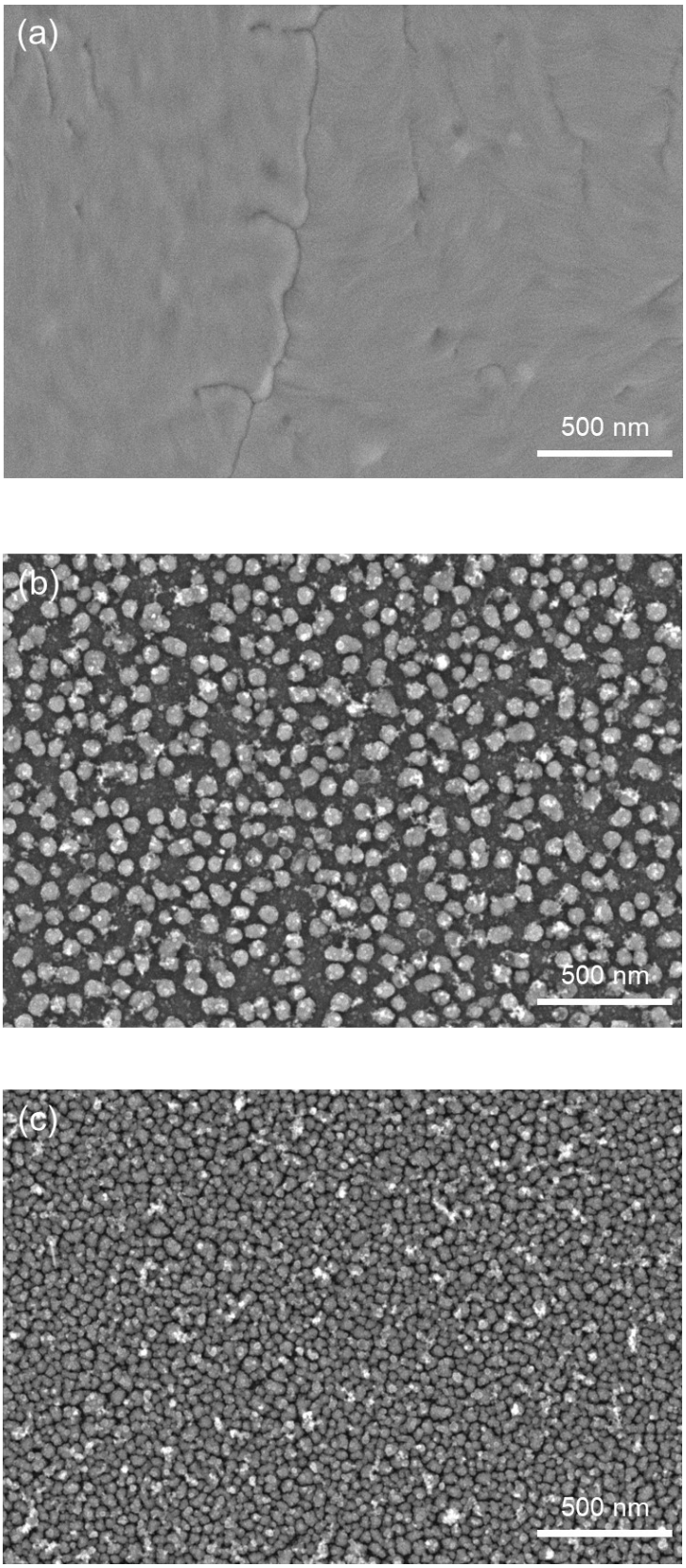

Fig. S1. SEM micrographs presenting broad views of typical glass plates coated with (a) 20 nm perovskite (forming a perovskite substrate), (b) 20 nm perovskite followed by 7 nm Ag (forming an Ag-perovskite substrate), and (c) 7 nm Ag (forming an Ag-substrate).

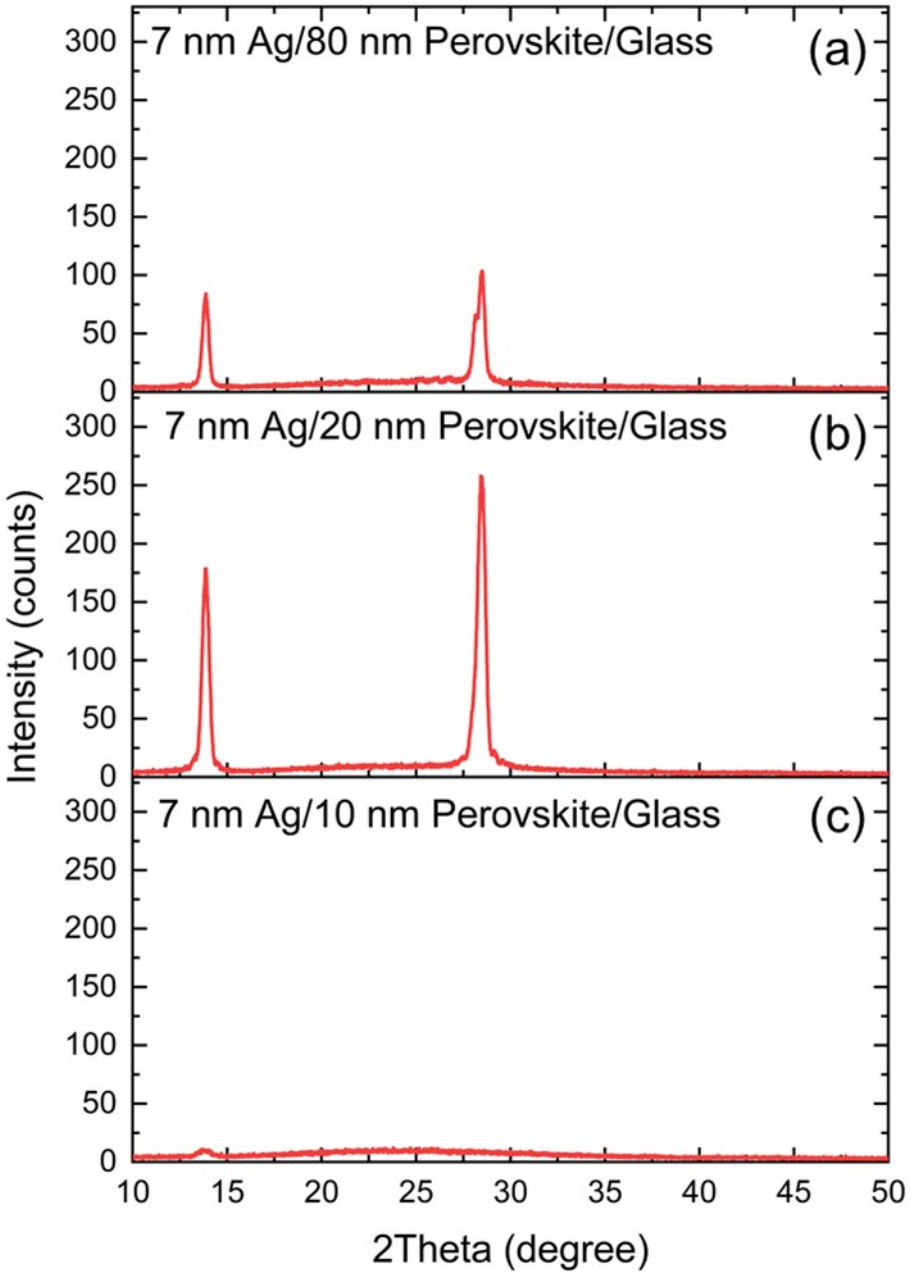

Fig. S2. Typical XRD spectra of Ag-perovskite substrates with perovskite layer thicknesses of (a) 80 nm, (b) 20 nm, and (c) 10 nm.

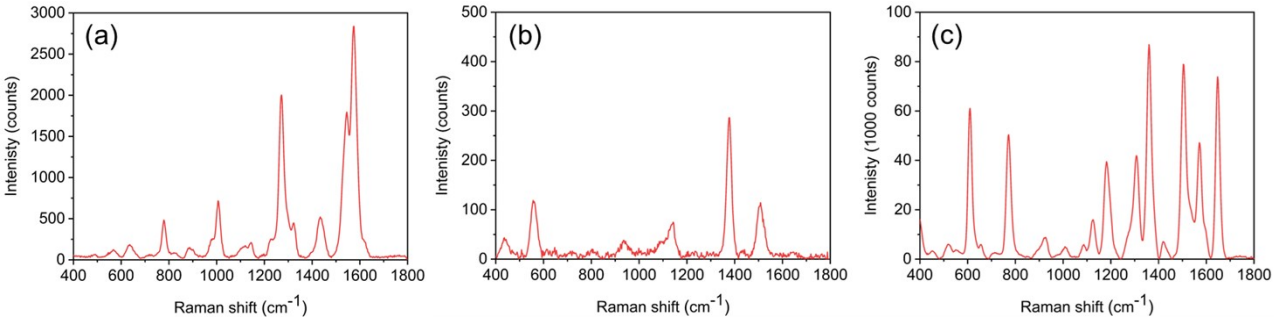

Fig. S3. Typical SERS spectra of (a) 10^{-4} M TBZ, (b) 5×10^{-5} M thiram, and (c) 10^{-5} M R6G obtained using Ag-perovskite substrates with a 20-nm perovskite layer under excitation wavelength of 532 nm. All spectra are normalized to the same detection conditions and subjected to background subtraction.

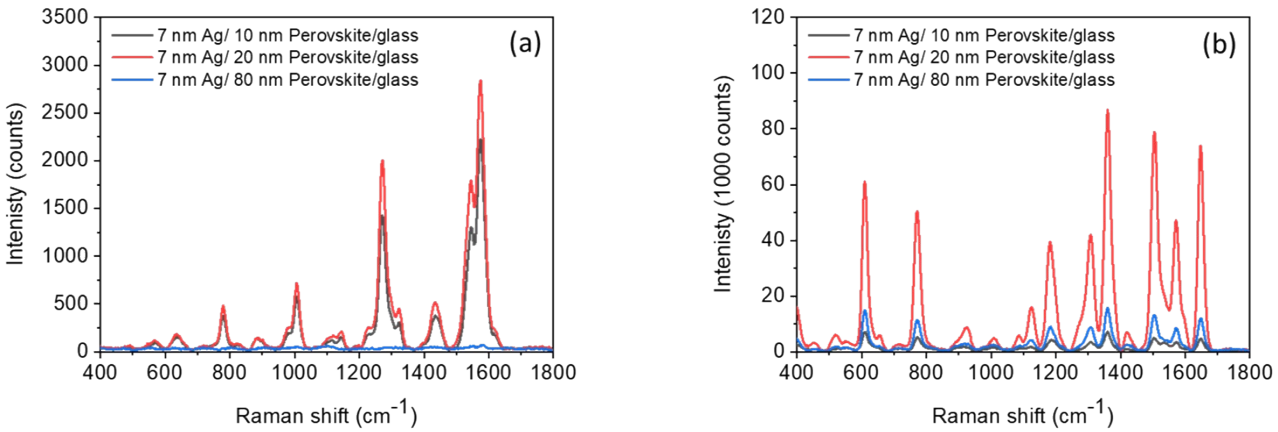

Fig. S4. Typical SERS spectra of (a) 10^{-4} M TBZ and (b) 10^{-5} M R6G obtained using Ag-perovskite substrates with perovskite layer thicknesses of 10 nm (black curves), 20 nm (red curves), and 80 nm (blue curves) under excitation wavelength of 532 nm. All spectra are normalized to the same detection conditions and subjected to background subtraction.

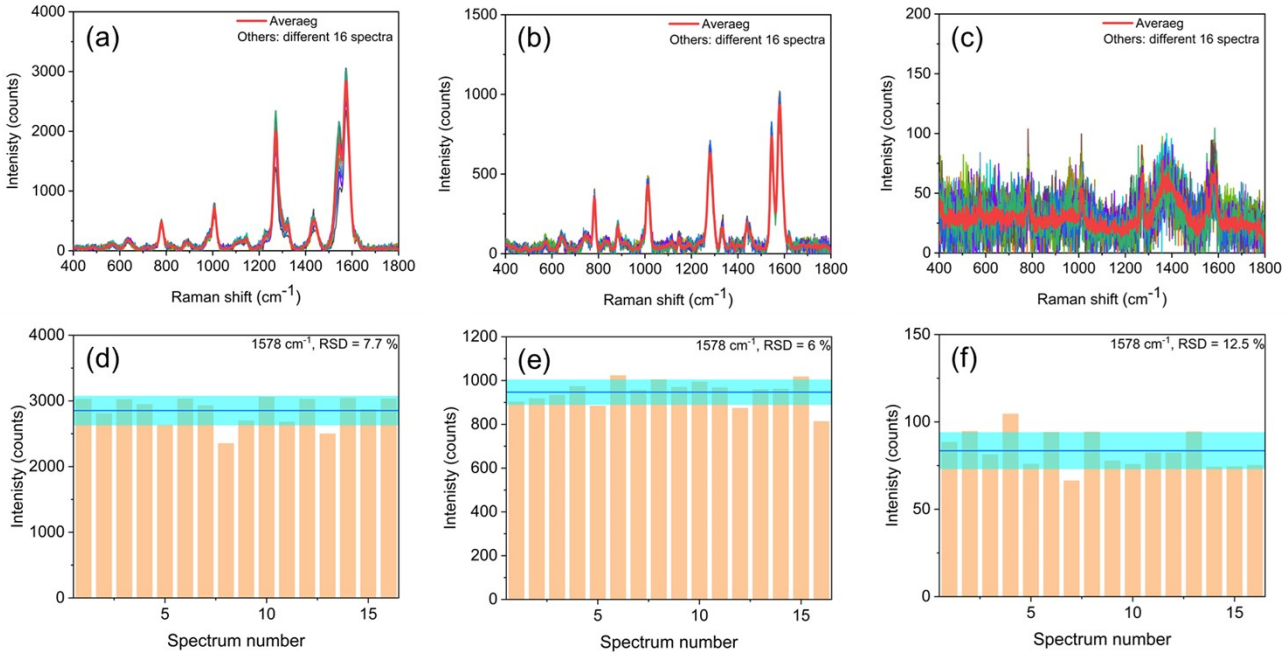

Fig. S5. 16 SERS spectra (colored curves) and their average (red curve) of 10^{-4} M TBZ using an Ag-perovskite substrate under excitation wavelengths of (a) 532 nm, (b) 633 nm, and (c) 785 nm. All spectra are normalized to the same detection conditions and subjected to background subtraction. The histograms in (d), (e), and (f) display the peak intensities at 1578 cm^{-1} extracted from the spectra in (a), (b), and (c), respectively. The blue lines in (d), (e), and (f) represent the corresponding average intensities, while the light blue regions indicate the fluctuation ranges based on the standard deviations (SDs) of the corresponding intensities. The relative standard deviations (RSDs) of the corresponding intensities are calculated and displayed in (d), (e), and (f).

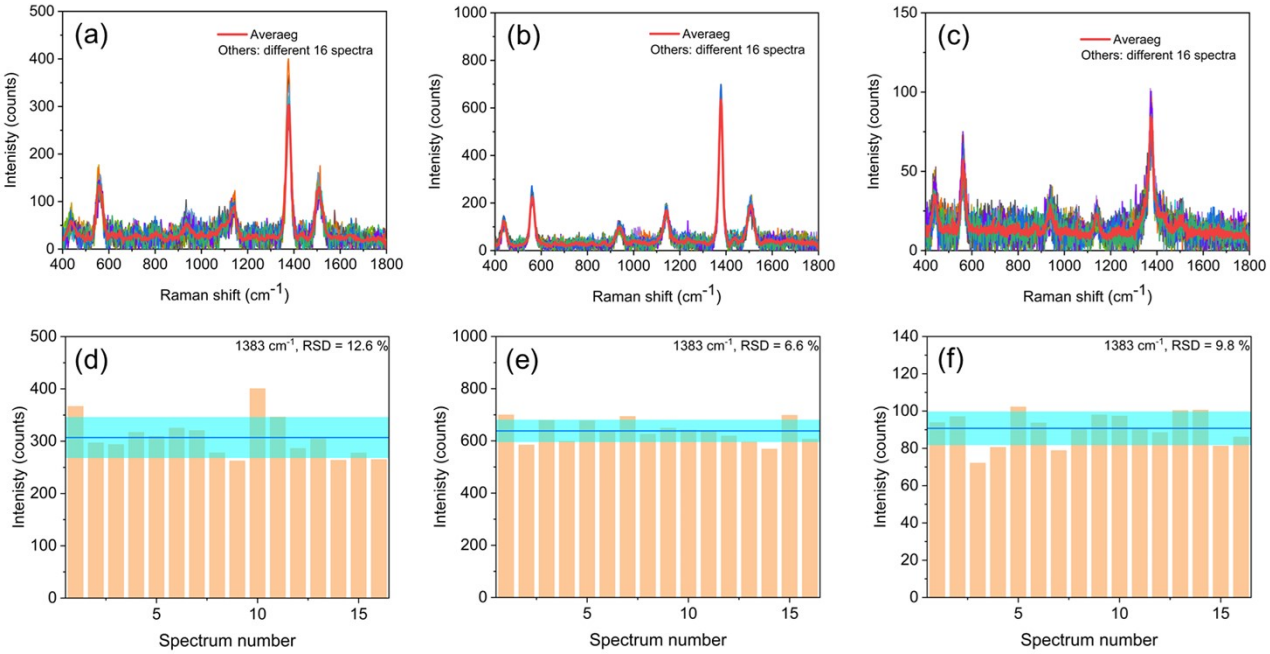

Fig. S6. 16 SERS spectra (colored curves) and their average (red curve) of 5×10^{-5} M thiram using an Ag-perovskite substrate under excitation wavelengths of (a) 532 nm, (b) 633 nm, and (c) 785 nm. All spectra are normalized to the same detection conditions and subjected to background subtraction. The histograms in (d), (e), and (f) display the peak intensities at 1383 cm^{-1} extracted from the spectra in (a), (b), and (c), respectively. The blue lines in (d), (e), and (f) represent the corresponding average intensities, while the light blue regions indicate the fluctuation ranges based on the standard deviations (SDs) of the corresponding intensities. The relative standard deviations (RSDs) of the corresponding intensities are calculated and displayed in (d), (e), and (f).

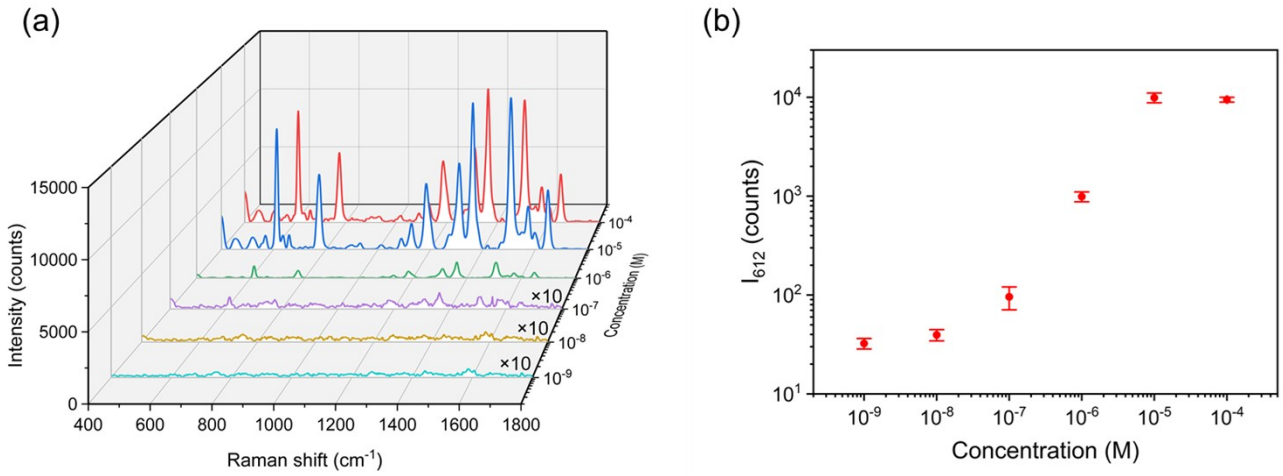

Fig. S7. (a) Average SERS spectra of R6G with different concentrations using an Ag-perovskite substrate under excitation wavelengths of 633 nm. Each average was calculated from 16 spectra. All spectra are normalized to the same detection conditions and subjected to background subtraction. (b) The plot utilizes the spectral data from (a) to depict peak intensities at 612 cm^{-1} (I_{612}) as functions of R6G concentrations.

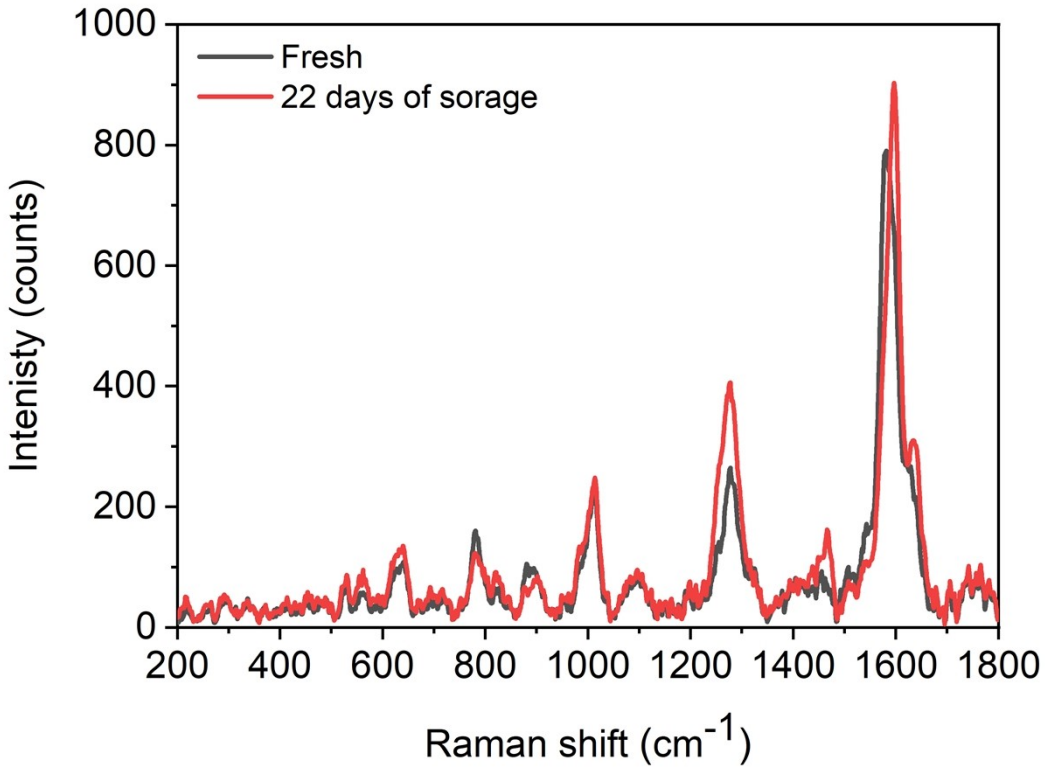

Fig. S8. SERS spectra of 10^{-4} M TBZ in apple juice using a fresh Ag-perovskite substrate (black curve) and an Ag-perovskite substrate stored for 22 days (red curve).