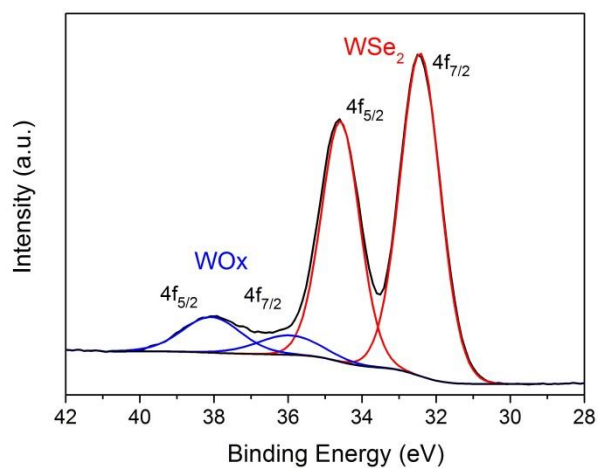
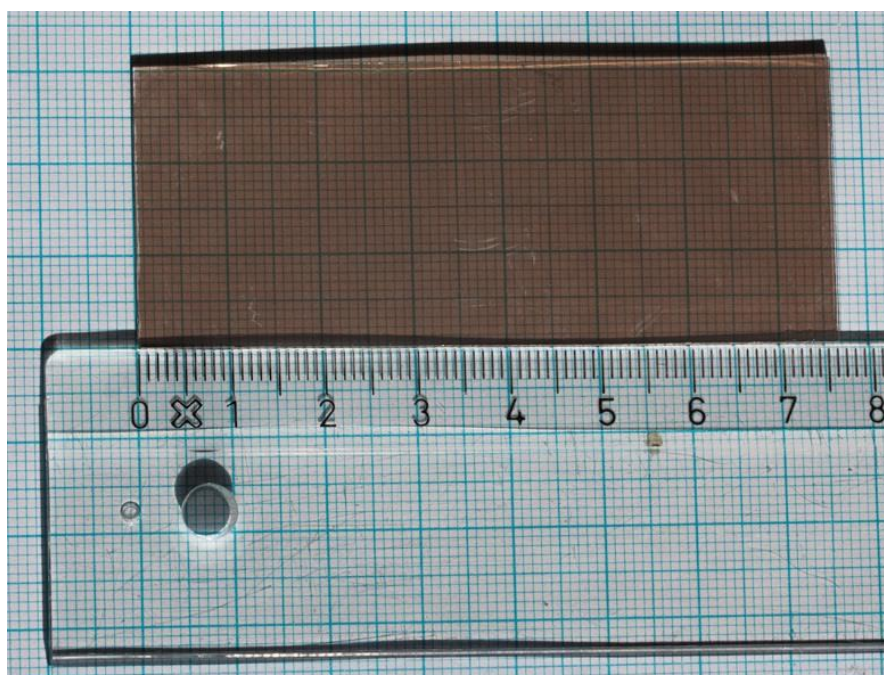


Supplementary Figures

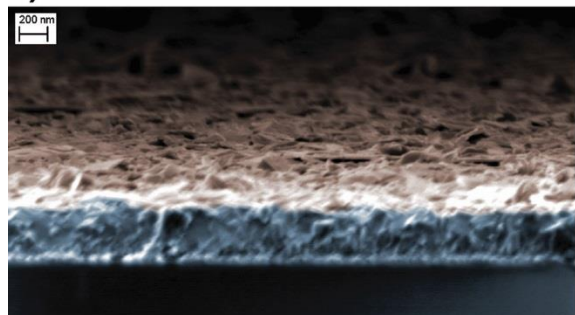


Supplementary Figure 1. The W core level XPS spectrum obtained on a SCSA deposited WSe₂ film.

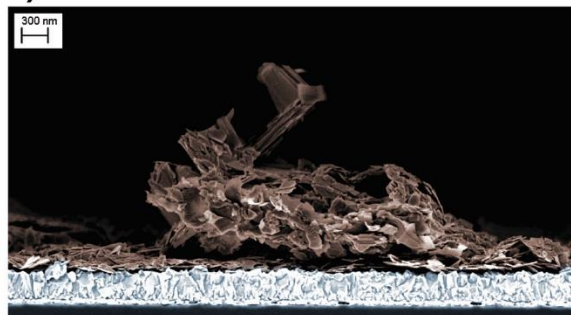


Supplementary Figure 2. A single flake layer WSe₂ film on a glass substrate prepared by the SCSA method. The area of the substrate is 22.5 cm². A few scratches are noted on the film due to rough handling.

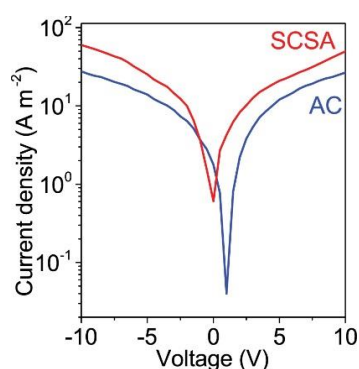
a) SCSA



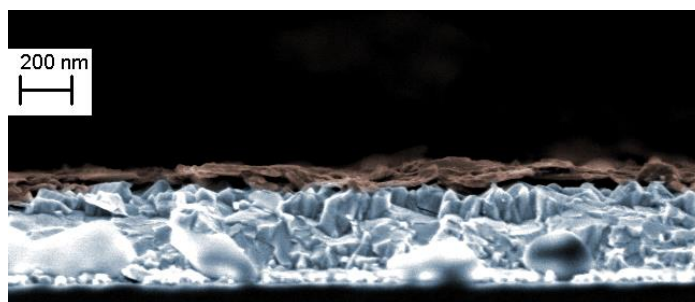
b) AC



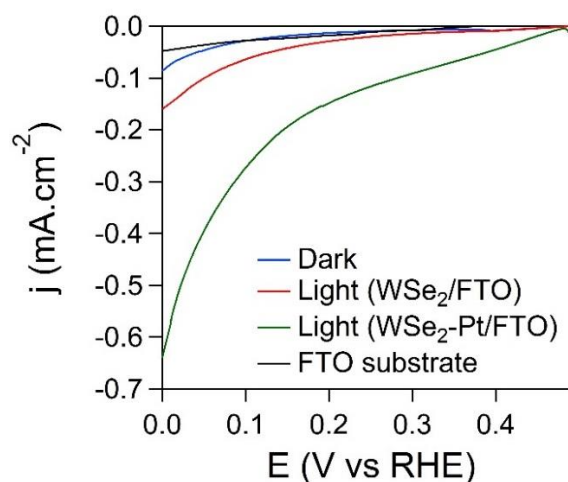
Supplementary Figure 3. Additional cross-sectional SEM images. Panel (a) shows a tilt-shift view (stage at 3°) of the SCSA film to highlight the single-flake nature of the film and the slight roughness induced by the FTO surface. Panel (b) shows a representation of the large aggregates present in the AC film. The SEM images are coloured to highlight the F:SnO₂ substrate (blue) and the WSe₂ (brown).



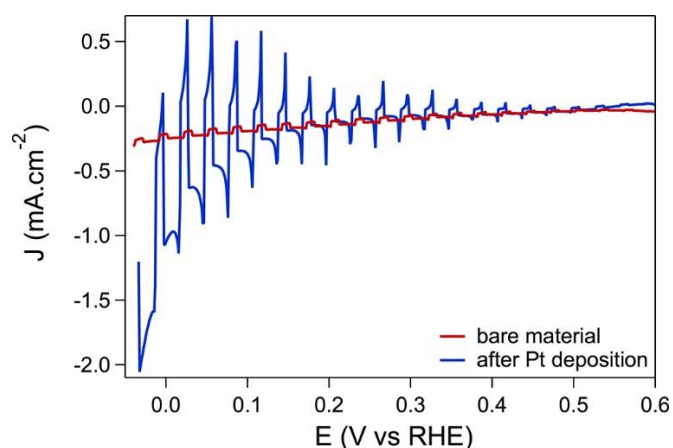
Supplementary Figure 4. The J-V data for the conductivity measurement on the 60 μm channel device as described in the main text. We note the shift of the minimum current by 1 V in conductivity measurement of AC film, which can be attributed to capacitance created during the scan.



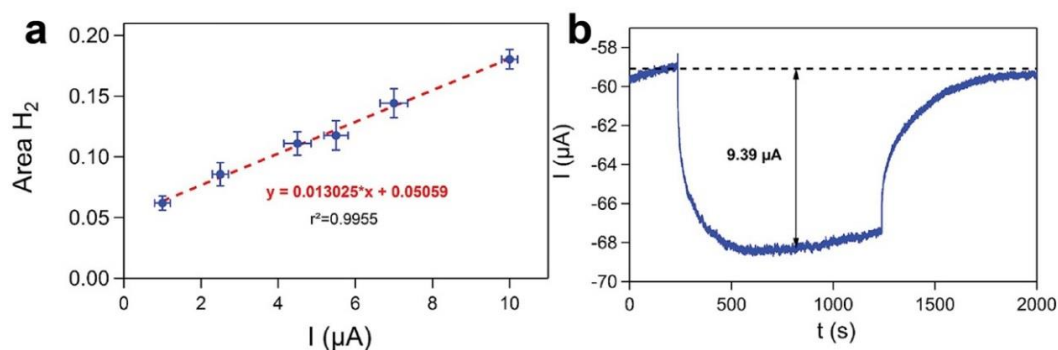
Supplementary Figure 5. Cross-sectional SEM image of a 2 layer SCSA WSe₂ film. A similar morphology is observed as in the 1 layer case (Figure 3c, main text)



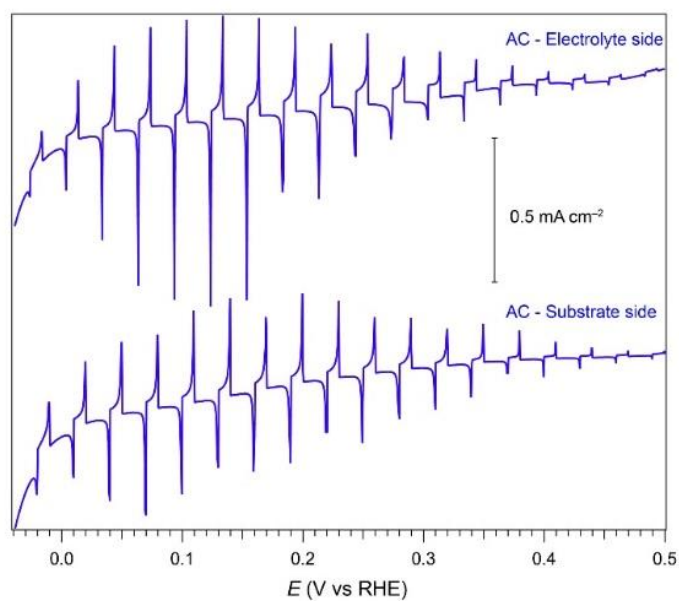
Supplementary Figure 6. Linear scanning voltammetry curves for the WSe_2 under constant dark or illumination conditions. Scan rate 10 mV s^{-1} in $1\text{M H}_2\text{SO}_4$ electrolyte.



Supplementary Figure 7. Linear scanning voltammetry under intermittent illumination of the best performing 2-layer SCSA WSe_2 film before (red curve) and after (blue curve) Pt deposition.



Supplementary Figure 8. H_2 measurements and Faradaic efficiency calculation. (a) Shows the calibration curve constructed using Pt electrodes. (b) Shows the raw photocurrent data from the SCSA WSe_2 photocathode measured.



Supplementary Figure 9. Comparison of the linear scanning voltammetry under intermittent 1 sun illumination in 1M H₂SO₄ electrolyte of the Pt-functionalized AC WSe₂ film.

Supplementary Tables

Supplementary Table 1. Summary of conductivity measurements.

| Device geometry | | | Measured conductivity (S m ⁻¹) | |
|---------------------|--------------------|--|--|----------------------|
| Channel Length (μm) | Channel Width (mm) | | SCSA film | AC film |
| 60 | 1 | | 6.5×10 ⁻⁴ | 1.8×10 ⁻⁴ |
| 20 | 3 | | 7.2×10 ⁻⁴ | 2.4×10 ⁻⁴ |