Supporting Information

Large area growth of silver and gold telluride ultrathin films via chemical vapor tellurization

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1. Finite element method (FEM) simulations

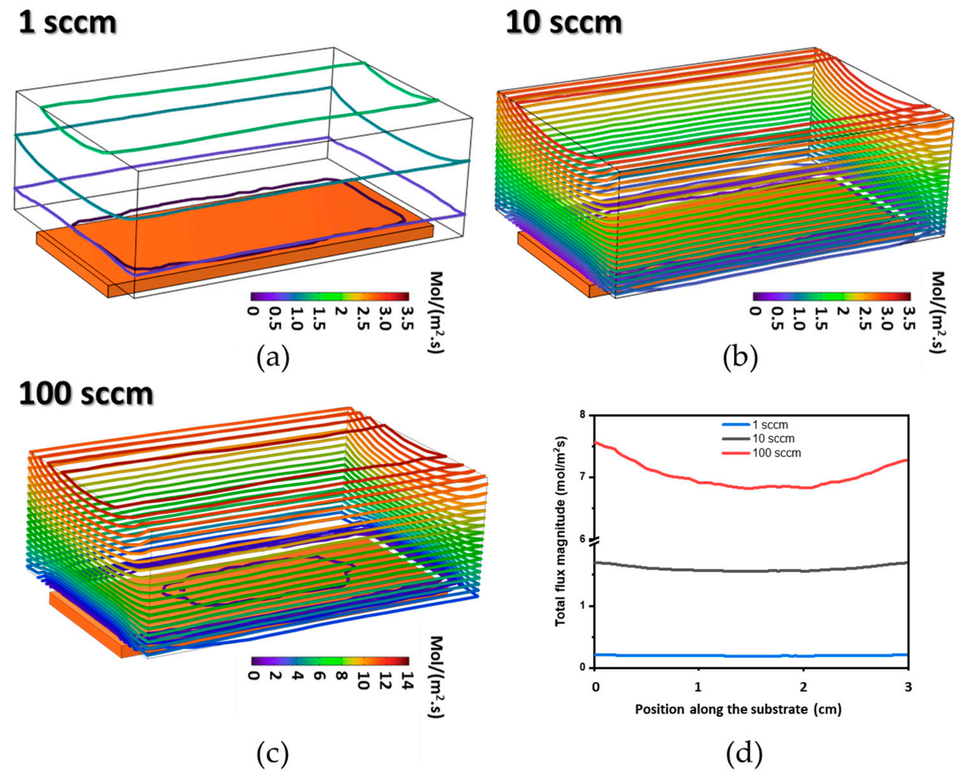


Figure S1 FEM simulation results of the precursor (tellurium powder) flux (represented by colorful contour lines) at the volume (cube) above the substrate (depicted in orange color) for the carrier gas flux of (a) 1 sccm and (b) 10 sccm (c) 100 sccm (d) quantitative comparison of the precursor flux along an arbitrary line above the substrate.

2. X-Ray photoelectron spectroscopy (XPS) of silver telluride.

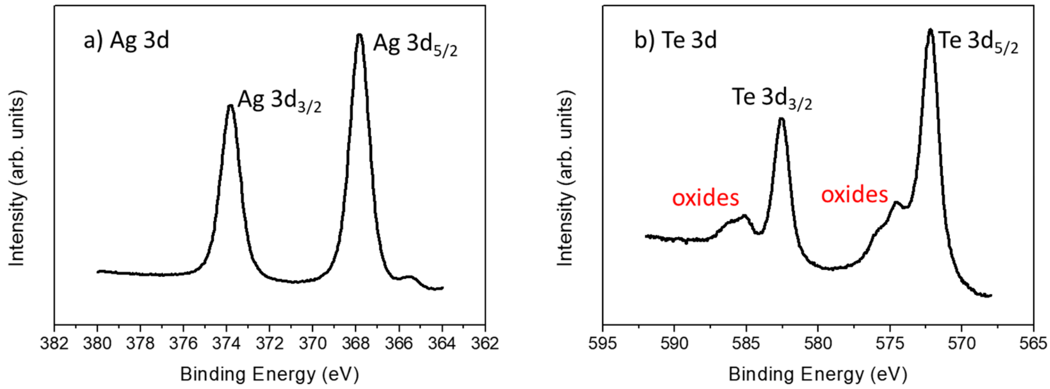
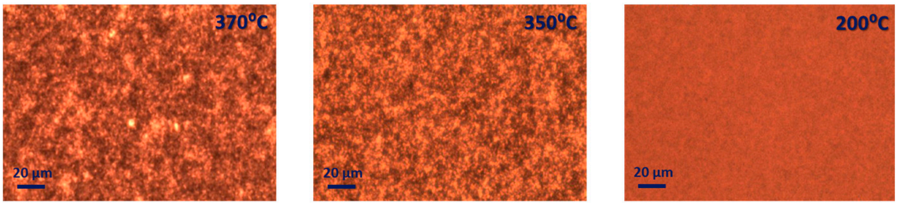


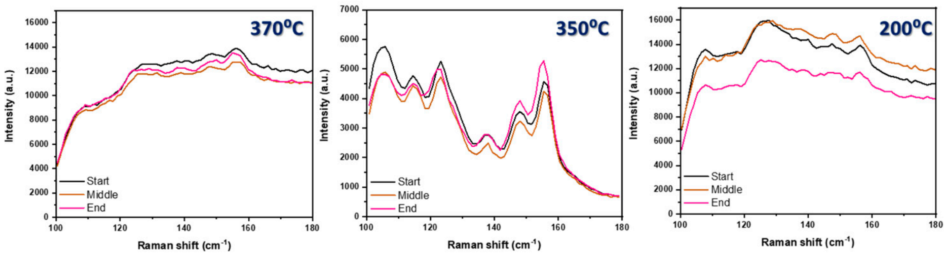
Figure S2 a) Ag 3d and b) Te 3d core levels detected by XPS investigation on the sample obtained by tellurization of silver substrate at 350°C.

3. Effect of temperature on the growth of $AuTe_2$

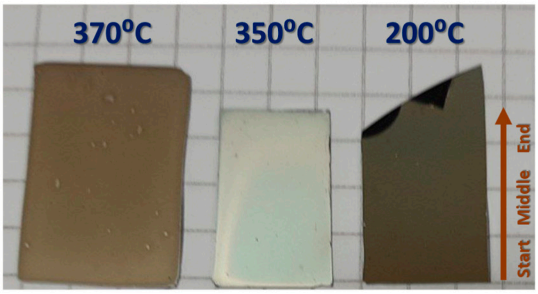
The effect of temperature on the $AuTe_2$ growth is studied by slightly increasing the growth temperature from 350°C to 370°C and lowering it down to 200°C to examine the effect on the grown material. Figure SI-3 a shows the optical microscope image of the sample grown at 370°C which displays shinier spots compared to the sample grown at 350°C reflecting the goldish color of the substrate. In addition, the Raman spectroscopy performed on the sample grown at 370°C shows suppressed Raman peaks at 108, 126, 138, 147, and 156 cm^{-1} compared to the $AuTe_2$ sample grown at 350°C (Figure SI-3 b). Furthermore, by lowering the growth temperature down to 200°C, leads to a distinct material texture observed through optical microscope. Raman spectroscopy performed on the sample grown at 200°C shows the weak Raman peaks located at 108, 126, 138, 148, and 156 cm^{-1} (Figure SI-3 b). In this case, we realize that there is an enhancement of the intensity of the peaks located at 126 cm^{-1} and 138 cm^{-1} which can be attributed to the tellurium Raman peaks. In addition, the enhancement in the Raman intensity derived from gold background reveals a more deposition of tellurium rather than its reaction between tellurium and gold substrate. Therefore, we hypothesize that at higher temperatures the re-evaporation of $AuTe_2$ can take place, while at lower temperatures reaction between tellurium and gold remains incomplete.



(a)



(b)



(c)

Figure S3 (a) optical microscope images of the samples grown at 370°C, 350°C, and 200°C (from left to right) (b) Raman spectroscopy performed on three spots located at start, middle and end of samples grown at 370°C, 350°C, and 200°C (from left to right) (c) images of the samples grown at 370°C, 350°C, and 200°C (from left to right)

4. Large scale AFM topographies of the $AuTe_2$ obtained starting from the evaporated Au on SiO_2/Si and single crystal Au/Mica

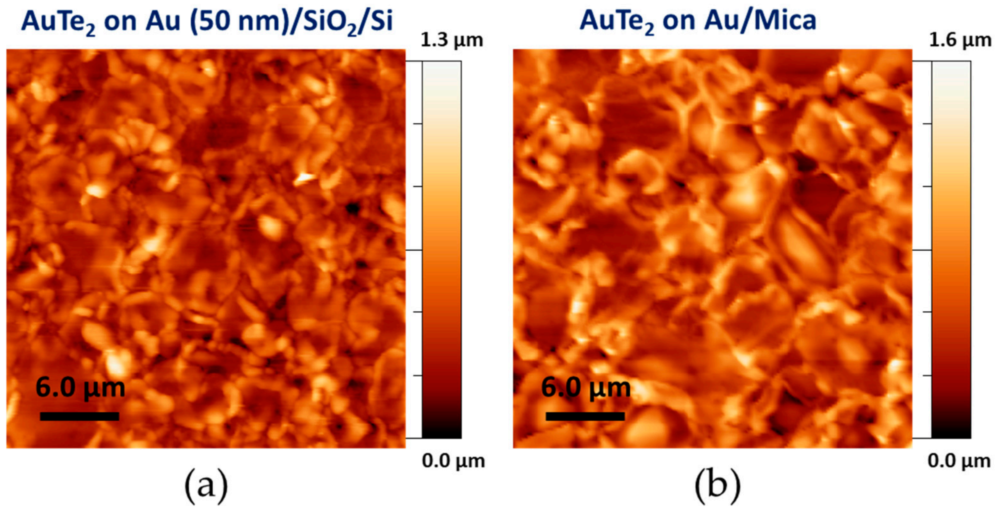


Figure S4 AFM topography image performed on 30 µm × 30 µm scan area of $AuTe_2$ obtained starting from (a) Au (50 nm)/SiO_2/Si (b) single crystal Au/Mica

5. Raman spectroscopy performed on $AuTe_2$ obtained starting from the evaporated Au (10 nm) and Au (5nm) on SiO_2/Si

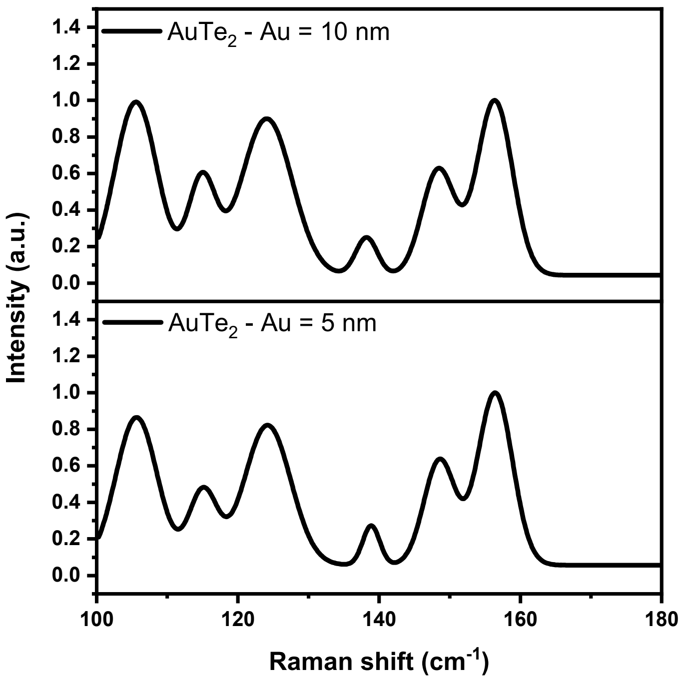
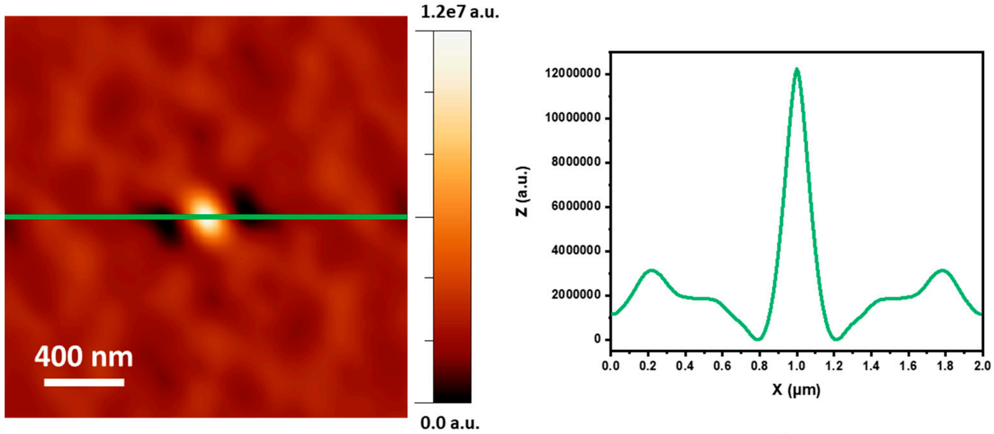


Figure S5 Raman spectra acquired on $AuTe_2$ films starting from 10 nm Au substrate thickness (top), and 5 nm Au substrate thickness (bottom)

6. $AuTe_2$ grain size calculation from AFM



(a) (b)

Figure S6 (a) Self-correlation filter applied to the topography images of $AuTe_2$ obtained starting from evaporated Au (10nm) on SiO_2/Si (b) FWHM of the central peak measuring the average grain size