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Supporting Information:
Effects of annealing temperature and ambient
on metal-PtSe₂ contact alloy formation

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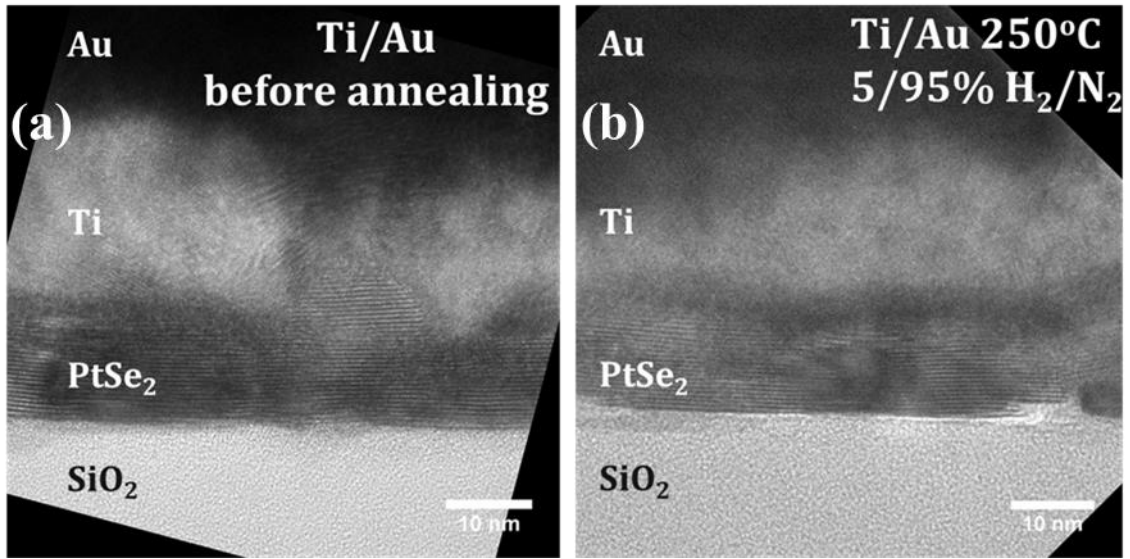


Figure S1: Representative cross-section TEM images of the PtSe₂ contacted with Ti/Au (a) before and (b) after annealing at 250 °C in FG, showing that the layered structure of the PtSe₂ is maintained after annealing.

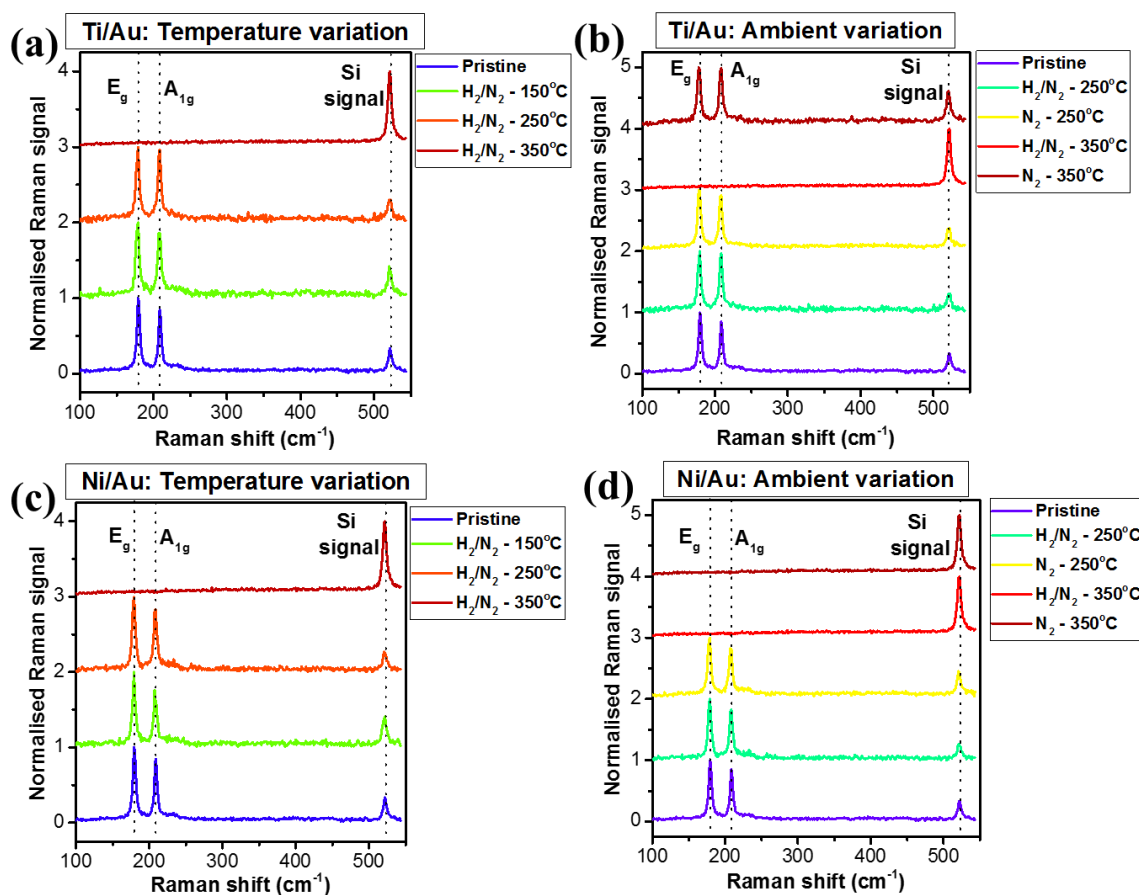


Figure S2: Raman signal collected from the PtSe₂ region (not the alloy region) after each annealing variation. (a) and (c) show the Raman signal after annealing in forming gas for each temperature for the Ti/Au and Ni/Au samples respectively. (b) and (d) show the Raman signal after annealing at 250 °C and 350 °C in FG and inert environment for the Ti/Au and Ni/Au samples respectively. When the annealing condition is too harsh the PtSe₂ signal is lost.

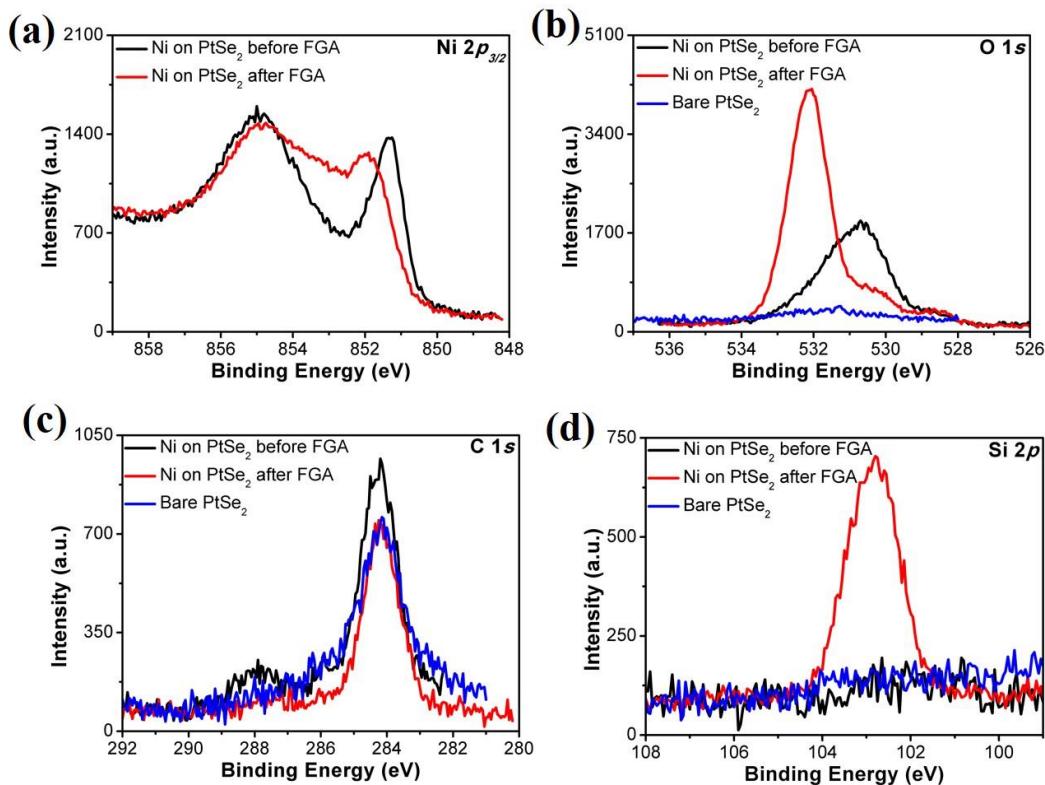


Figure S3: Additional XPS spectra of as-deposited Ni/PtSe₂ samples. a) Ni 2 $p_{3/2}$, (b) O 1 s , (c) C 1 s , and (d) Si 2 p spectra.

Figure S2 shows spectra of the as-deposited Ni on PtSe₂ in addition to those included in the main article. The Ni 2 $p_{3/2}$ spectra show a metallic Ni signal at 851.2 eV, and a broad peak centered at ~853 eV. This higher BE peak cannot be directly attributed to the formation of a NiSe_x due to the number of complex satellite peaks present at higher BE in a Ni 2 p spectra, along with the multiple peak splitting which can occur for Ni compounds. The O 1 s spectra shows an increase in oxidation (compared to bare PtSe₂) following Ni deposition. This is primarily due to oxidation of the Nickel surface. No significant change in the C 1 s or Si 2 p signal is observed between bare PtSe₂ and Ni on PtSe₂, indicating no C contamination, or thinning of the PtSe₂ layer (which would lead to an increased Si signal).

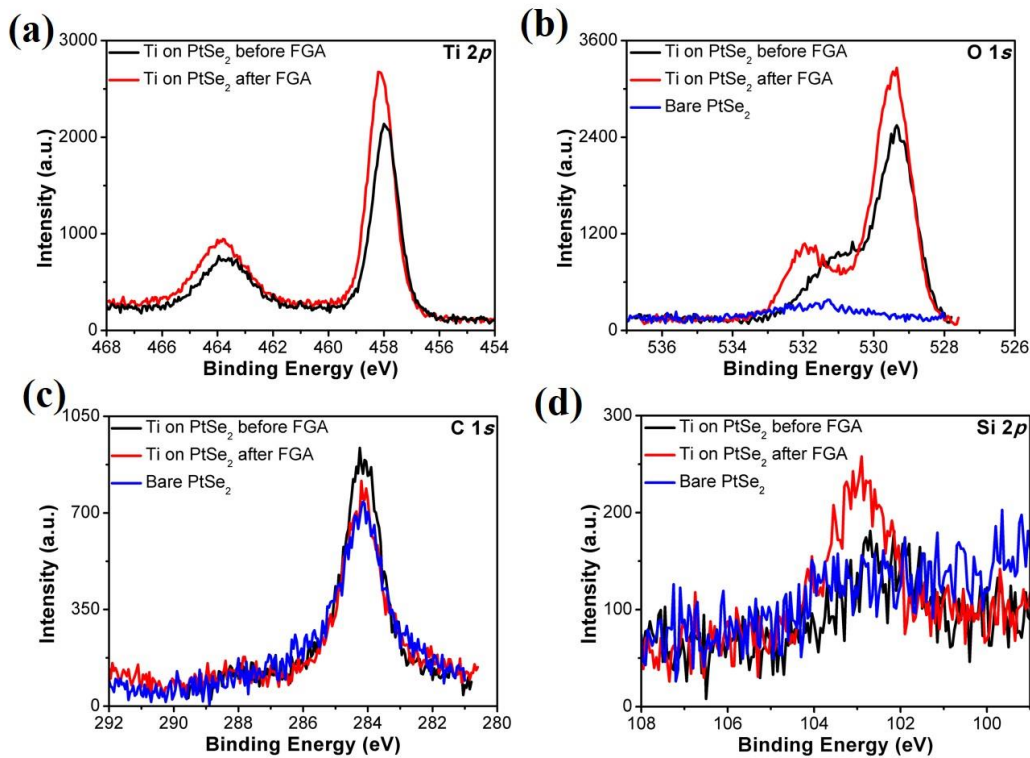


Figure S4: Additional XPS spectra of as-deposited Ti/PtSe₂ samples. a) Ti 2*p*, (b) O 1*s*, (c) C 1*s*, and (d) Si 2*p* spectra.

Figure S3 shows additional spectra of the as-deposited Ti on PtSe₂. The Ti 2*p* spectra show a no evidence of a metallic Ti signal rather the peak shape and position are that expected for TiO₂. This is expected given the very low formation energy of TiO₂, and the oxygen-gettering nature of Ti. This complete oxidation of the Ti (BE = 529.5 eV) can also be clearly seen in the drastic increase in the O 1*s* signal. No significant change in the C 1*s* or Si 2*p* signal is observed between bare PtSe₂ and Ti on PtSe₂, again indicating no C contamination, or thinning of the PtSe₂ layer.