Supporting Information

Nonthermal plasma enhanced chemical vapor deposition of two-dimensional molybdenum disulfide

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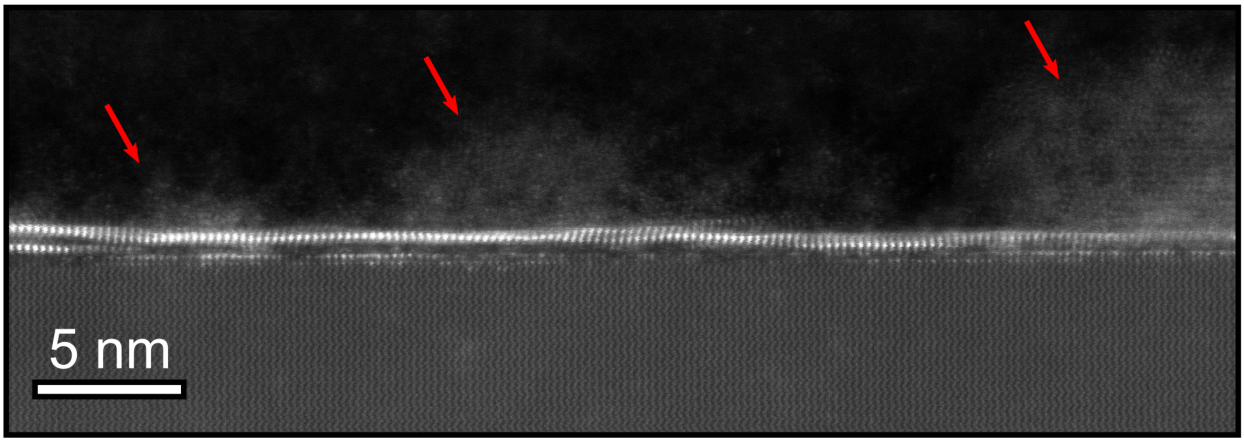

Figure S1: Cross-sectional HAADF-STEM analysis of an MoS_2 film on sapphire (Al_2O_3) produced with 2 minutes of deposition time, 137 W of power, and 5 sccm $Ar_{precursors}$. Nanoparticle-like features on the surface are indicated with red arrows.

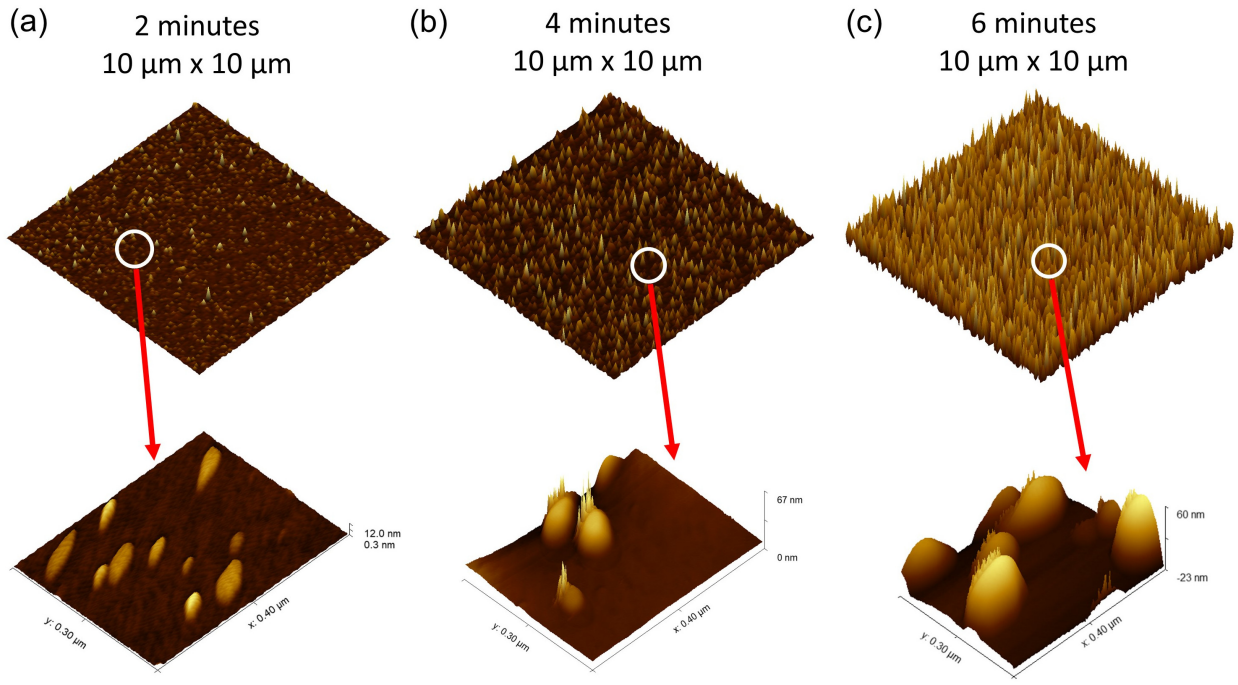

Figure S2: AFM MoS_2 nanoparticle-like films on sapphire (Al_2O_3) imaged at a) 2 minutes b) 4 minutes and c) 6 minutes.

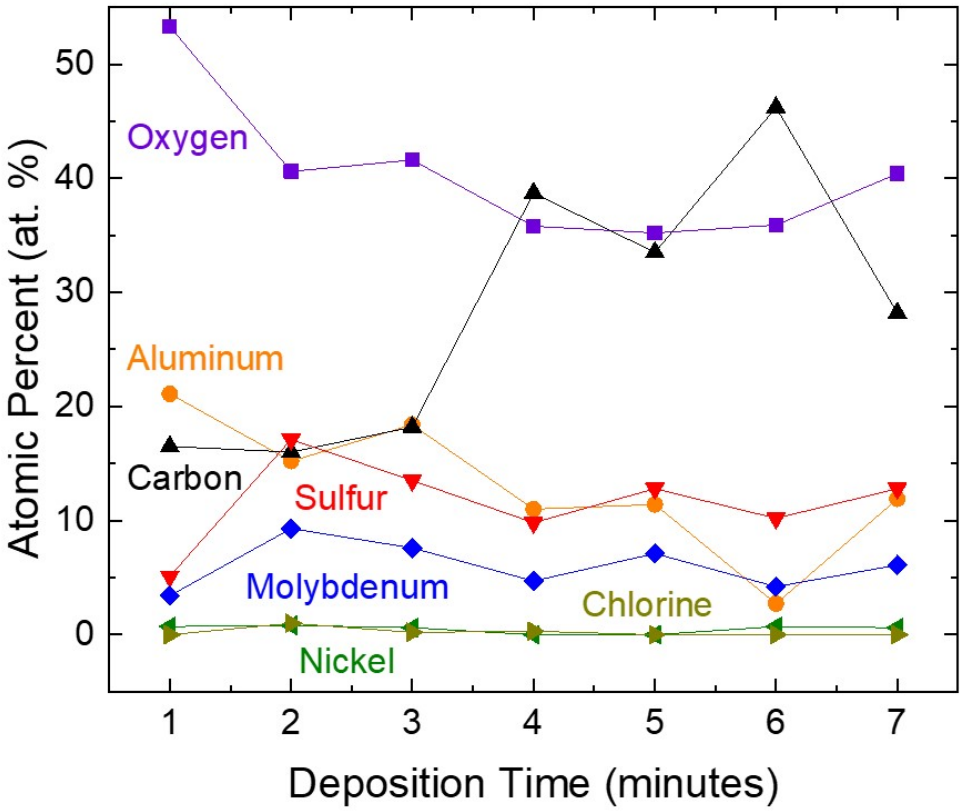

Figure S3: Atomic percent of MoS_2 films on sapphire (Al_2O_3) as a function of deposition time in the plasma. XPS of films that were produced with run times longer than 3 minutes were taken after months of sitting in air which contributed to the large carbon peak.

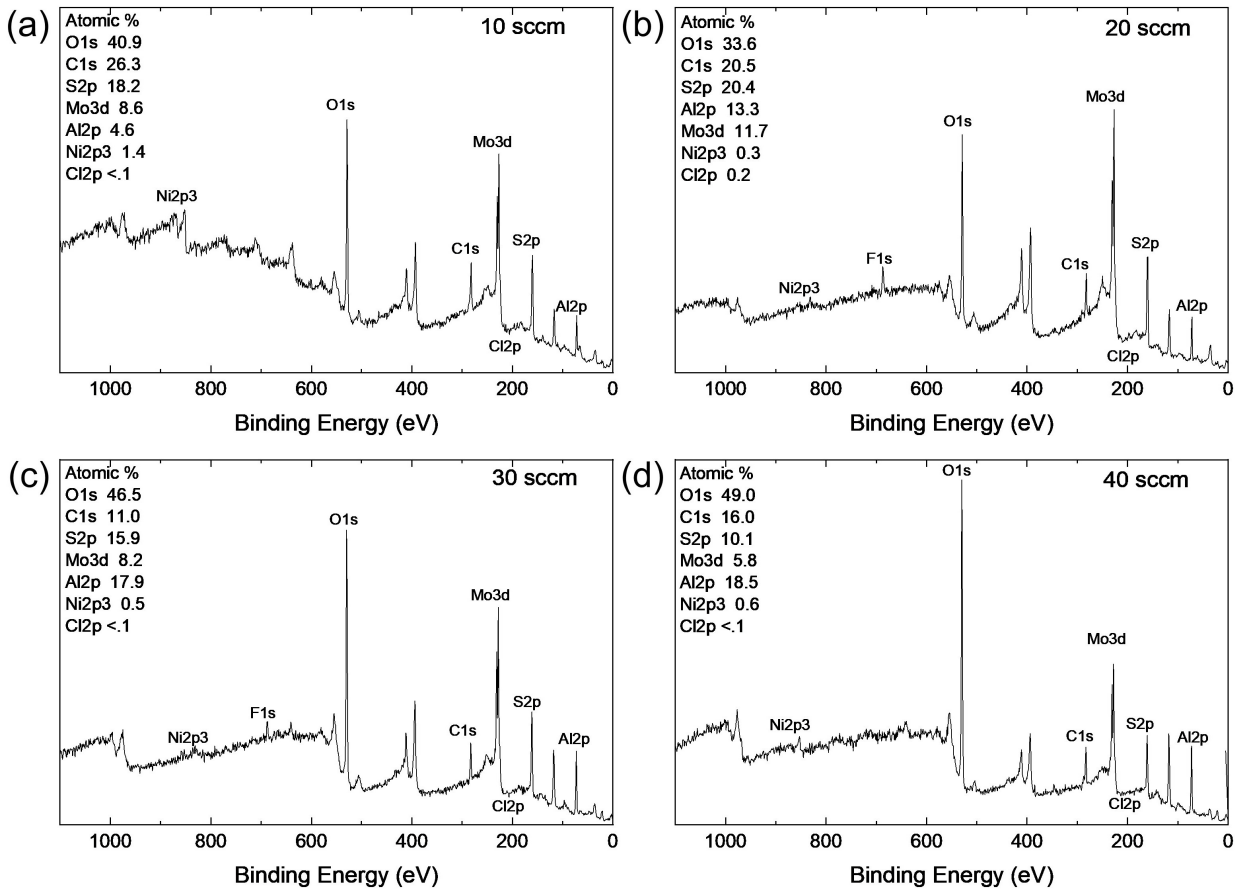

Figure S4: XPS Survey Scans for MoS_2 films on sapphire (Al_2O_3) a) 10 sccm b) 20 sccm c) 30 sccm d) 40 sccm

Survey scans were collected using a bandpass energy of 280 eV for 5 scans. In order to calculate the atomic percent, we used PHI's "Multipak" built-in atomic quantification feature. The procedure uses the intensity, I, of the peaks found from the survey scan along with a sensitivity factor, S, that is specific to each element and taken from PHI's database. This value is calculated for each material and the results are summed over all materials, N. The individual component found for one material is then divided by the sum to arrive at the atomic percentage of material, C_x:

$$\frac{I_x/S_x}{\sum_{i=1}^{N} I_i/S_i} = C_x. \tag{1}$$

In Figures S4b and S4c, small fluorine peaks were found, but were not included in the

total percentage of the films. We believe that these peaks are not from the actual process because none of the components in the reactor contain fluorine. Rather, we believe that the contamination is from other sources, such as from the XPS chamber or environment for a number of reasons. First, several samples of TiO_2, TiN, and MoS_2 prepared across three completely isolated and separate reactors were analyzed in the same XPS chamber, many of which were found to contain fluorine in similar quantities found here, between 0 and 3.5%. Second, those TiO_2, TiN, and MoS_2 samples that contained fluorine in the XPS survey scans were further submitted to STEM-EDX and Raman analysis where no indication of fluorine was found. Third, fluorine could not be fitted to any of the high-resolution scans for any of the elements of interest here leading us to the conclusion that these peaks are not relevant to the samples and were therefore not included in the atomic percentage of the films.