Electronic Supplementary Material (ESI) for Nanoscale Advances.

Supporting Information for

"Gold nanoparticles assisted synthesis of MoS_2 monolayer by chemical vapor deposition"

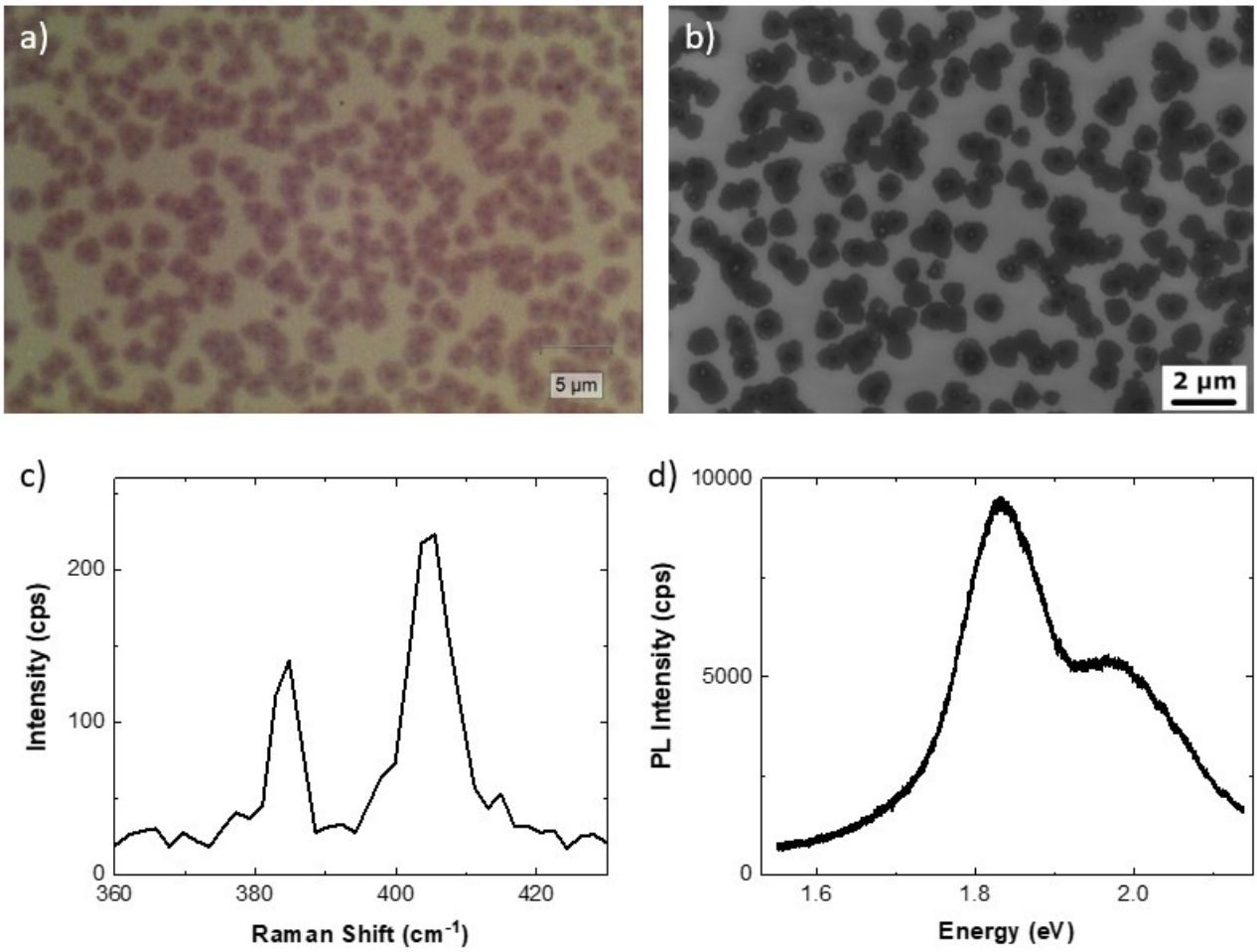

Figure S1. Analysis of MoS_2 synthesis without gold colloids. a) optical image of the MoS_2 flakes obtained without the assistance of gold colloids. b) SEM image of the MoS_2 flakes. The morphological analysis reveals that the MoS_2 flakes present irregular shapes with an average size 500 nm, rather smaller in comparison with the flake synthetized with the assistance of the gold colloids. The SEM image shows the presence of multilayer at the center of the flake probably related to the seeding of the flake. c) Raman spectrum of the MoS_2 flake, $\delta = 20.6$ cm^{-1}, indicating that the majority of the material is bilayer. d) PL spectrum of the MoS2 flakes, the spectrum can be deconvolved in three different emissions peaked at 1.73 eV, 1.83 eV and 1.97 eV, attributed to the trion, to the A exciton and the B exciton, respectively. The trion/exciton A ratio is 0.26 and 0.17, using the integrated area and peak intensity, respectively. The exciton B/ exciton A ratio is 1.3 and 0.65, using the integrated area and peak intensity, respectively.

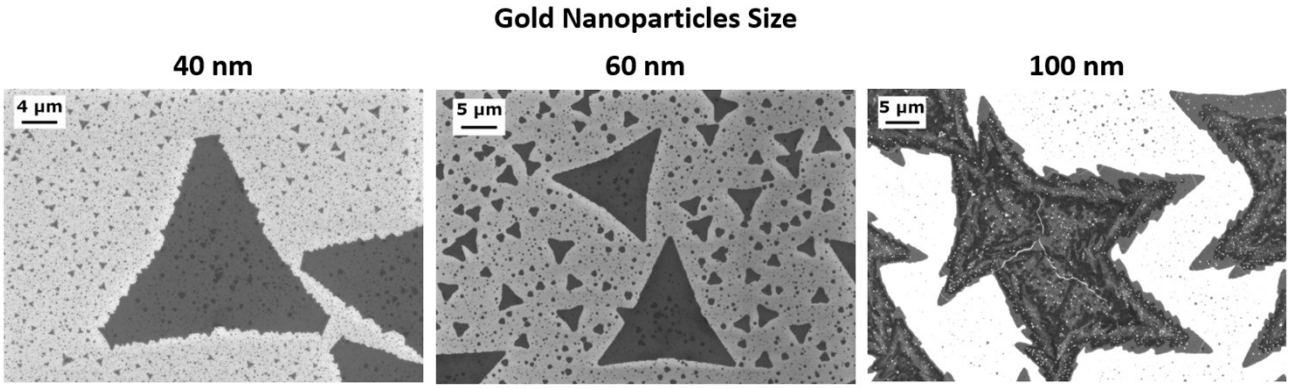

Fig S2. SEM images of the results of the gold assisted CVD synthesis, using nanoparticles of different size. In the left panel 40 nm gold nanoparticles are dispersed on the SiO_2 substrate, the CVD process results in truncated triangles with a lateral size of about 20 µm, where the triangle edges are strongly irregular. The presence of ad-layer islands is confirmed also in the case of the 40 nm gold nanoparticles. In the central panel it is shown the SEM image of the flakes obtained with the 60 nm gold nanoparticles, similar to the ones of the manuscript. It is worth noting that using 100 nm gold nanoparticles a dendritic growth occurs (right panel). This effect is probably due to the balance between the lateral and the vertical synthesis catalyzed by the gold nanoparticles. In this case the size of the nanoparticles over a certain limit affects drastically this balance giving rise to dendritic structures with a larger amount of multilayer MoS_2.

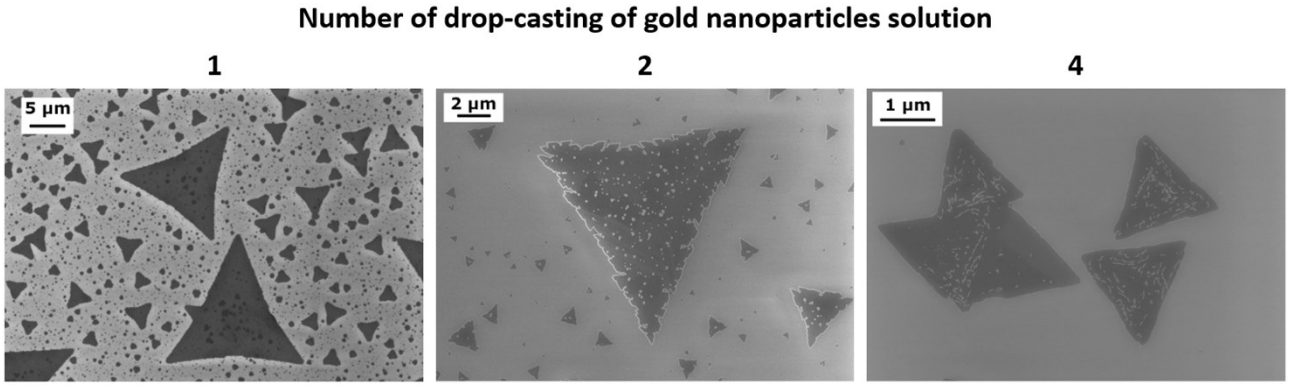

Fig S3. SEM images of the results of the gold assisted CVD synthesis, using a different number of drop-cast of 100 µL solution of gold nanoparticles. In the left panel, the synthesis depicted in the manuscript using one drop-casting. In the central panel, the SEM image reveals that, using a higher concentration of nanoparticles (two drop-casts of 100 µL solution) we obtain a MoS_2 triangular few-layer flake, with a 12 µm lateral size, where the nanoparticles have merged (the bright spots

inside the MoS_2 flake). The edges of the MoS_2 bilayer are strongly irregular. In the case of the four drop-casts (400 µL of gold nanoparticles solution). The CVD synthesis results in flakes with 1 µm lateral size, affected by the presence of vertical scales of MoS_2. In general, increasing the concentration of nanoparticles the vertical synthesis of MoS_2 is enhanced up to the formation of vertical scales with the fallout of decreasing the lateral size of two-dimensional MoS_2.

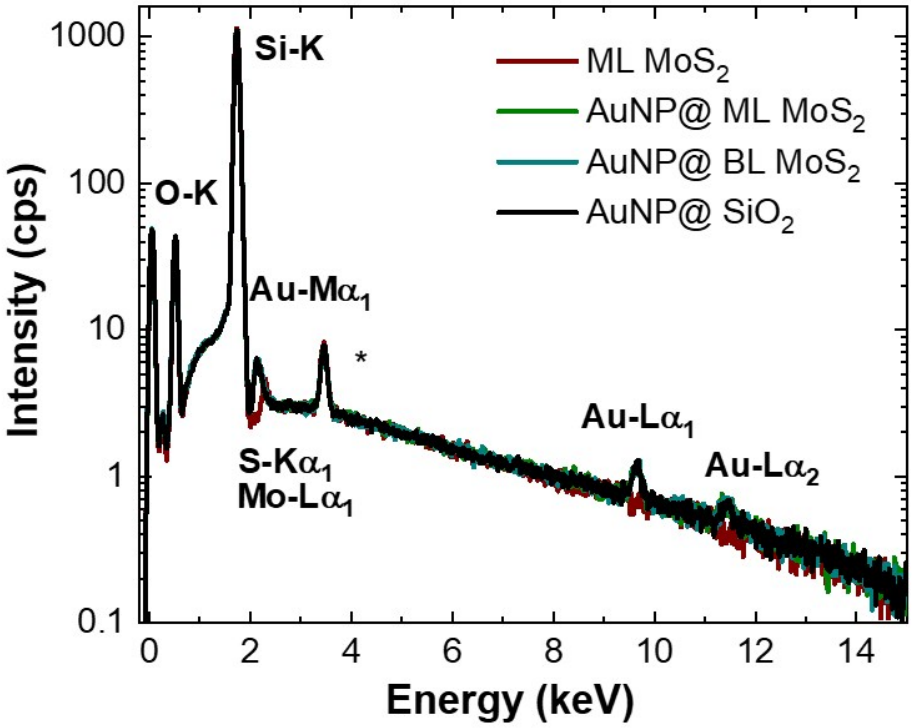

Figure S4. EDX spectral analysis. The EDX spectra reported in Figure 3 are reported on log scale on whole intensity range.

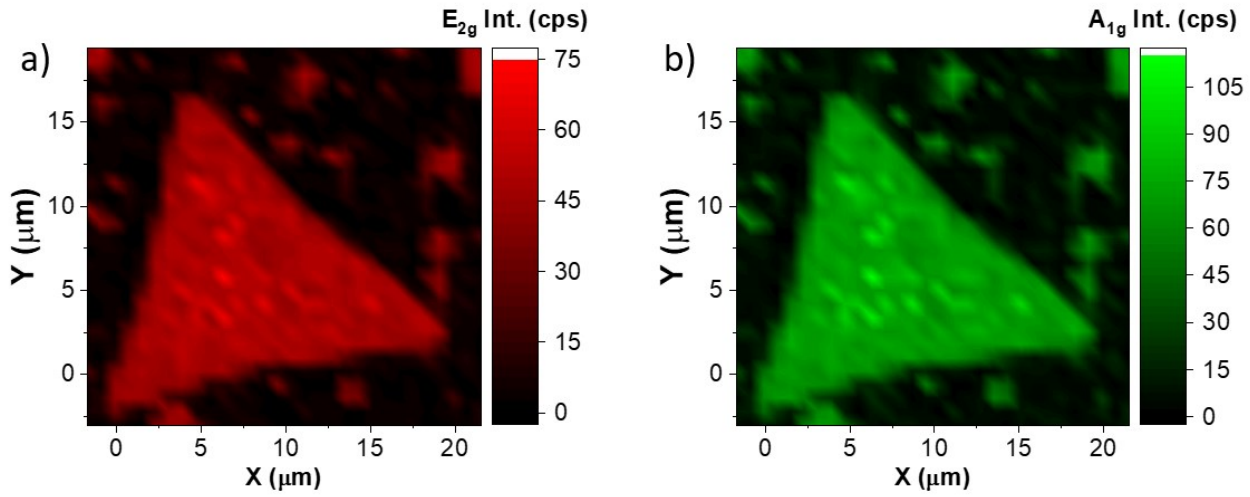

Figure S5. Raman intensity maps of the E_{2G} (Fig. S3 a) and A_{1G} modes (Fig. S3 b).

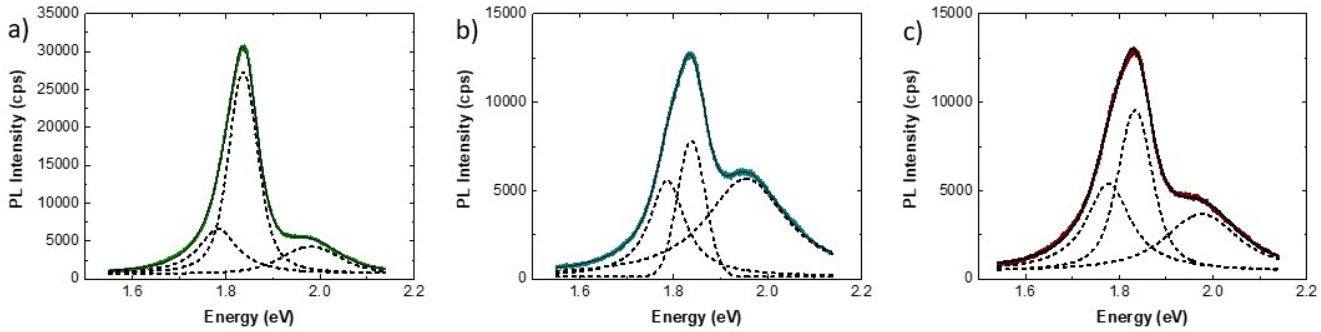

Figure S6. Voigt deconvolution of the PL spectra reported in Figure XX of the manuscript: a) monolayer MoS_2 PL spectrum, b) gold colloids coupled monolayer MoS_2 PL spectrum, c) micrometric bilayer island PL spectrum.

Table S1

MoS_2 ML	**Trion**	**Exciton A**	**Exciton B**
Peak Position (eV)	1.78	1.84	1.98
Line width (eV)	0.10	0.07	0.15
Integrated Intensity (a.u.)	927	2523	685
Integrated Intensity Ratio (a.u.)	0.37	1	0.27

Table S2

AuNP/MoS_2 ML	**Trion**	**Exciton A**	**Exciton B**
Peak Position (eV)	1.78	1.84	1.95
Line width (eV)	0.09	0.07	0.18
Integrated Intensity (a.u.)	771	567	700
Integrated Intensity Ratio (a.u.)	1.36	1	3.1

Table S3

MoS_2 BL	**Trion**	**Exciton A**	**Exciton B**
Peak Position (eV)	1.79	1.84	1.98
Line width (eV)	0.11	0.09	0.18
Integrated Intensity (a.u.)	880	1056	864
Integrated Intensity Ratio (a.u.)	0.83	1	0.82