Electronic Supplementary Material (ESI) for Nanoscale.


# Preventing Sintering of Nanoclusters on Graphene by Radical Adsorption

A. J. Martínez-Galera*,[1,4] U. A. Schröder,[1] C. Herbig,[1] M. A. Arman, [2] J. Knudsen, [2,3] and T. Michely,[1]

[1] II. Physikalisches Institut, Universität zu Köln, Zülpicher Straße 77, D-50937 Köln, Germany.

[2] Division of Synchrotron Radiation Research, Lund University, Box 118, SE-221 00 Lund, Sweden.

[3] MAXIV Laboratory, Lund University, Box 118, SE-221 00 Lund, Sweden.

[4] Present address: Departamento de Física de la Materia Condensada, Universidad Autónoma de Madrid, E-28049 Madrid, Spain.

**Qualitative analysis of the thermal stability of clusters before and after the exposure to radicals of D and O**

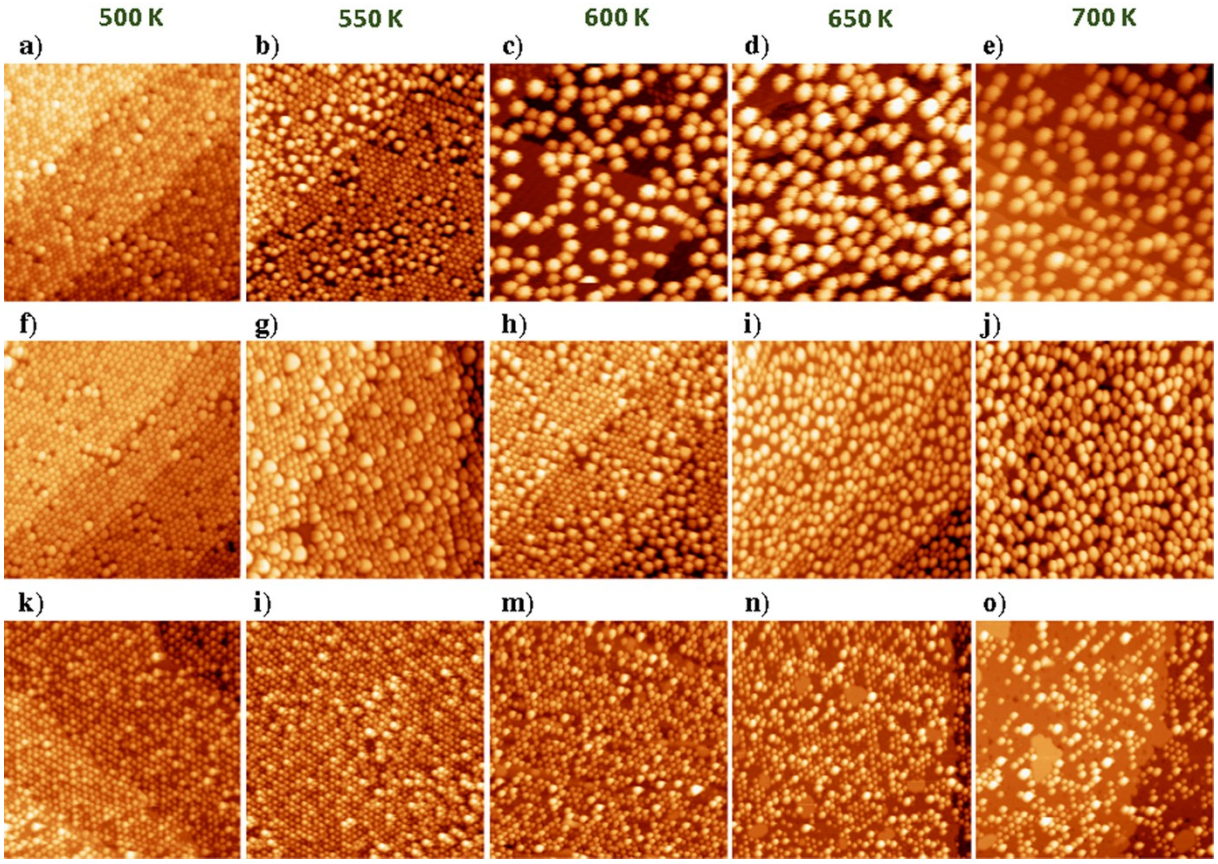


**Figure S1.** STM study of the evolution of Pt (0.4 ML) clusters on Gr/Ir(111), before and after the exposure to D and O radicals, along subsequent annealing cycles of 300 s in intervals of 50 K at temperatures in the range 500-700 K. **a)-e)** Sequence of STM topographs acquired on the pristine sample –without radicals–; **f)-j)** Sequence of STM images acquired after the exposure of the pristine sample to 1.8 L atomic D; **k)-o)** Sequence of STM topographs obtained after the exposure of the as-grown clusters on graphene/Ir(111) to 1.8 L atomic O. Tunnelling parameters: a) $V_s$ = +0.8 V, $I_T$ = 0.62 nA, b) $V_s$ = +2.1 V, $I_T$ = 0.18 nA, c) $V_s$ = +2.1 V, $I_T$ = 0.084 nA, d) $V_s$ = +2.1V, $I_T$ = 0.076 nA, e) $V_s$ = +2.1V, $I_T$ = 0.092 nA, f) $V_s$ = +1.8 V, $I_T$ = 1.0 nA, g) $V_s$ = +1.6 V, $I_T$ = 0.34 nA, h) $V_s$ = +1.8 V, $I_T$ = 0.23 nA, i) $V_s$ = +1.8 V, $I_T$ = 0.39 nA, j) $V_s$ = +1.8 V, $I_T$ = 0.26 nA, k) $V_s$ = +2.1 V, $I_T$ = 0.4 nA, l) $V_s$ = +1.9 V, $I_T$ = 0.46 nA, m) $V_s$ = +2.6 V, $I_T$ = 0.32 nA, n) $V_s$ = +2.7 V, $I_T$ = 0.3 nA, o) $V_s$ = +1.8 V, $I_T$ = 0.46 nA. The size is 90 × 90 $nm^2$ for all of the topographs.

**Quantitative analysis of the thermal stability of clusters before and after the exposure to radicals of D and O**

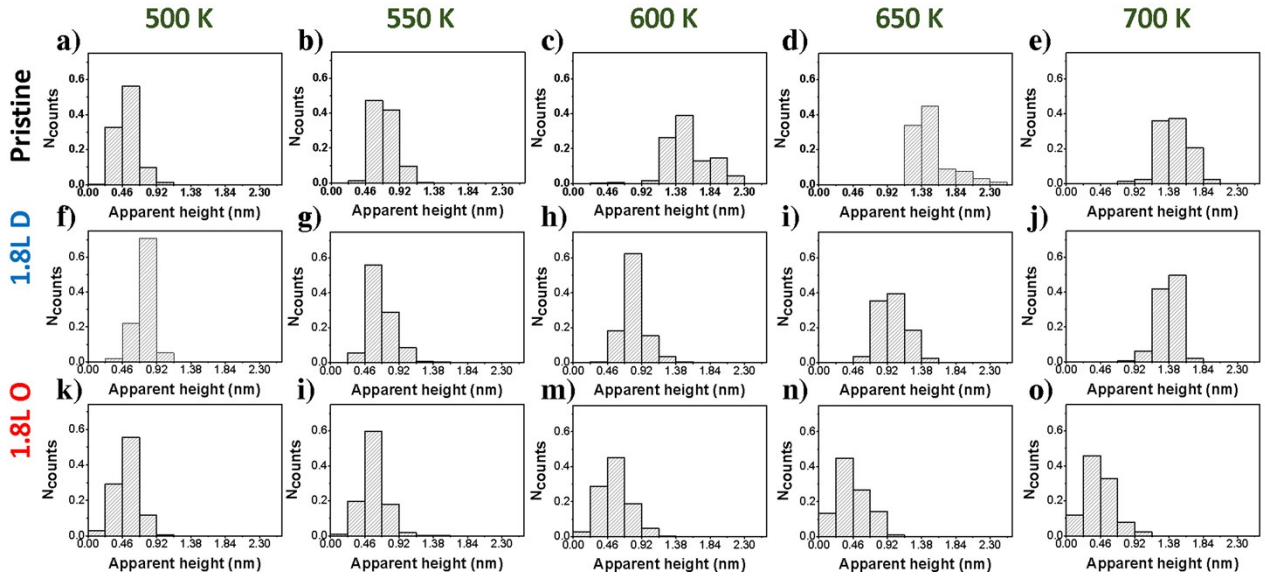


**Figure S2**. Histograms illustrating the evolution of the apparent height distribution are shown for **a)-e)** a pristine sample, that is in absence of radicals, **f)-j)** a pristine sample after the exposure to 1.8 L atomic D and **k)-o)** a pristine sample after the exposure to 1.8 L atomic O.

**Influence of the exposure amount to O radicals on the thermal stability of clusters**

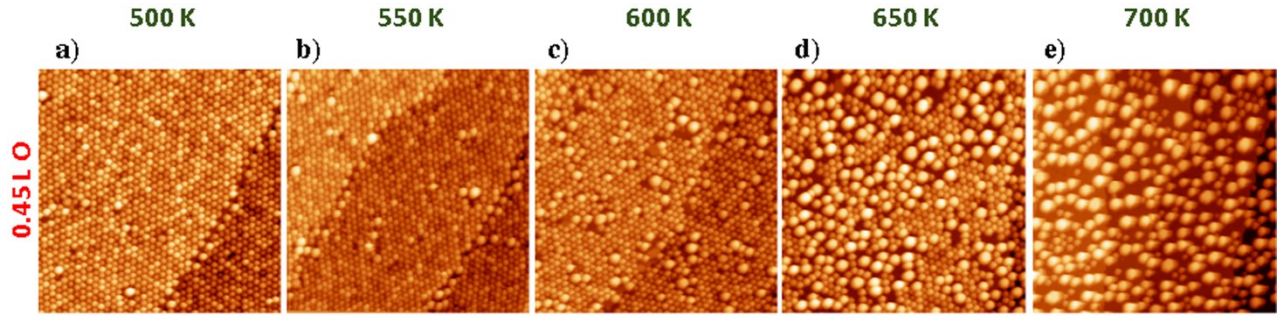


**Figure S3.** Study of the evolution of Pt (0.4 ML) clusters adsorbed on Gr/Ir(111) after the exposure to 0.45 L atomic oxygen and sequential 300 s annealing steps of 50 K between 500 K and 700 K. Tunneling parameters: a) $V_s$ = +1.8 V, $I_T$ = 0.085 nA, b) $V_s$ = +1.9 V, $I_T$ = 0.11 nA, c) $V_s$ = +1.9 V, $I_T$ = 0.12 nA, d) $V_s$ = +1.9 V, $I_T$ = 0.089 nA, e) $V_s$ = +2.2 V, $I_T$ = 0.07 nA. The size is 90 × 90 $nm^2$ for all of the topographs.

**Influence of the exposure to molecular oxygen on the thermal stability of clusters**

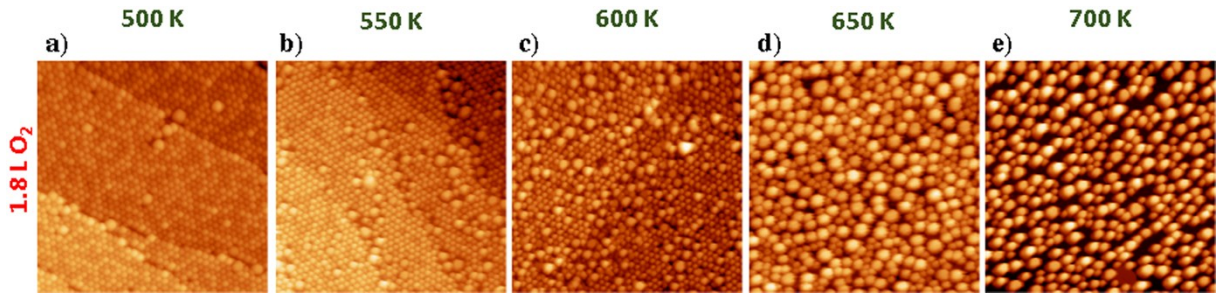


**Figure S4.** Sequence of STM topographs illustrating the thermal stability of clusters grown by depositing 0.4 ML Pt on Gr/Ir(111) after the exposure to 1.8 L molecular oxygen and sequential annealing steps of 300 s between 500 and 700 K in intervals of 50 K. Tunneling parameters: a) $V_s$ = +1.6 V, $I_T$ = 0.11 nA, b) $V_s$ = +1.6 V, $I_T$ = 0.094 nA, c) $V_s$ = +1.6 V, $I_T$ = 0.1 nA, d) $V_s$ = +1.8 V, $I_T$ = 0.098 nA, e) $V_s$ = +2.0 V, $I_T$ = 0.082 nA. The size is 90 × 90 nm$^2$ for all of the topographs.

**Quantitative analysis of the exposure amount to O radicals**

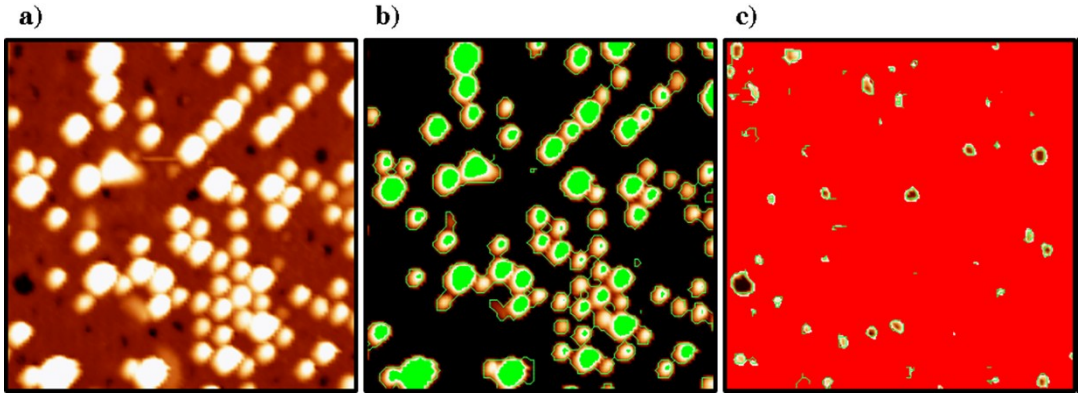


**Figure S5.** Estimation of the area fraction of holes induced by graphene etching. **a)** STM topograph after the final annealing step for a sample, where at 300 K an amount of 0.4 ML Pt had been deposited and subsequently exposed to 1.8 L atomic O. **b)** Schematics highlighting the area covered by clusters, which is 34.2 % of the image size. **c)** Schematics highlighting the area occupied by the holes in graphene, which is 4.6 % of the image area, i.e. the hole area has a fraction of 7 % of the uncovered graphene area. Tunneling parameters: a) $V_s$ = +1.8 V, $I_T$ = 0.46 nA; size 43 × 43 nm$^2$.