Preventing Sintering of Nanoclusters on Graphene by Radical Adsorption

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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) $V_s = +0.8\ V$, $I_T = 0.62\ \text{nA}$, b) $V_s = +2.1\ V$, $I_T = 0.18\ \text{nA}$, c) $V_s = +2.1\ V$, $I_T = 0.084\ \text{nA}$, d) $V_s = +2.1\ V$, $I_T = 0.076\ \text{nA}$, e) $V_s = +2.1V$, $I_T = 0.092\ \text{nA}$, f) $V_s = +1.8\ V$, $I_T = 1.0\ \text{nA}$, g) $V_s = +1.6\ V$, $I_T = 0.34\ \text{nA}$, h) $V_s = +1.8\ V$, $I_T = 0.23\ \text{nA}$, i) $V_s = +1.8\ V$, $I_T = 0.39\ \text{nA}$, j) $V_s = +1.8\ V$, $I_T = 0.26\ \text{nA}$, k) $V_s = +2.1\ V$, $I_T = 0.4\ \text{nA}$, l) $V_s = +1.9\ V$, $I_T = 0.46\ \text{nA}$, m) $V_s = +2.6\ V$, $I_T = 0.32\ \text{nA}$, n) $V_s = +2.7\ V$, $I_T = 0.3\ \text{nA}$, o) $V_s = +1.8\ V$, $I_T = 0.46\ \text{nA}$. 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) $V_s = +1.8 \text{ V}$, $I_T = 0.085 \text{ nA}$, b) $V_s = +1.9 \text{ V}$, $I_T = 0.11 \text{ nA}$, c) $V_s = +1.9 \text{ V}$, $I_T = 0.12 \text{ nA}$, d) $V_s = +1.9 \text{ V}$, $I_T = 0.089 \text{ nA}$, e) $V_s = +2.2 \text{ V}$, $I_T = 0.07 \text{ nA}$. The size is $90 \times 90 \text{ nm}^2$ 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) \( V_s = +1.6 \text{ V} \), \( I_T = 0.11 \text{ nA} \), b) \( V_s = +1.6 \text{ V} \), \( I_T = 0.094 \text{ nA} \), c) \( V_s = +1.6 \text{ V} \), \( I_T = 0.1 \text{ nA} \), d) \( V_s = +1.8 \text{ V} \), \( I_T = 0.098 \text{ nA} \), e) \( V_s = +2.0 \text{ V} \), \( I_T = 0.082 \text{ nA} \). The size is 90 × 90 nm

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) \( V_s = +1.8 \text{ V} \), \( I_T = 0.46 \text{ nA} \); size 43 × 43 nm