

Supporting Information

Analysis of Diffusion Controlled Stochastic Events of Iridium Oxide (IrO_x) Single Nanoparticle Collisions by Scanning Electrochemical Microscopy

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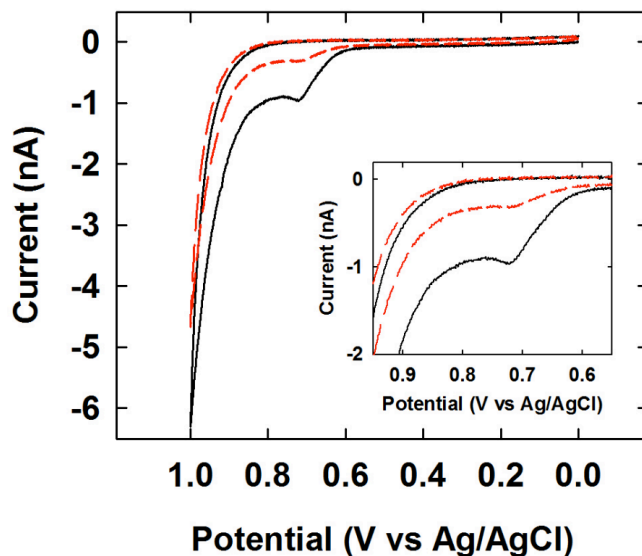


Figure S1. Cyclic voltammograms of water oxidation at NaBH₄-treated Pt UME (radius 5 μm) in pH 13 solution (0.1 M NaOH) first (black) and second (red) scan at 4 pM IrO_x NP after immersion of about 3 min. Scan rate is 50 mV/s.

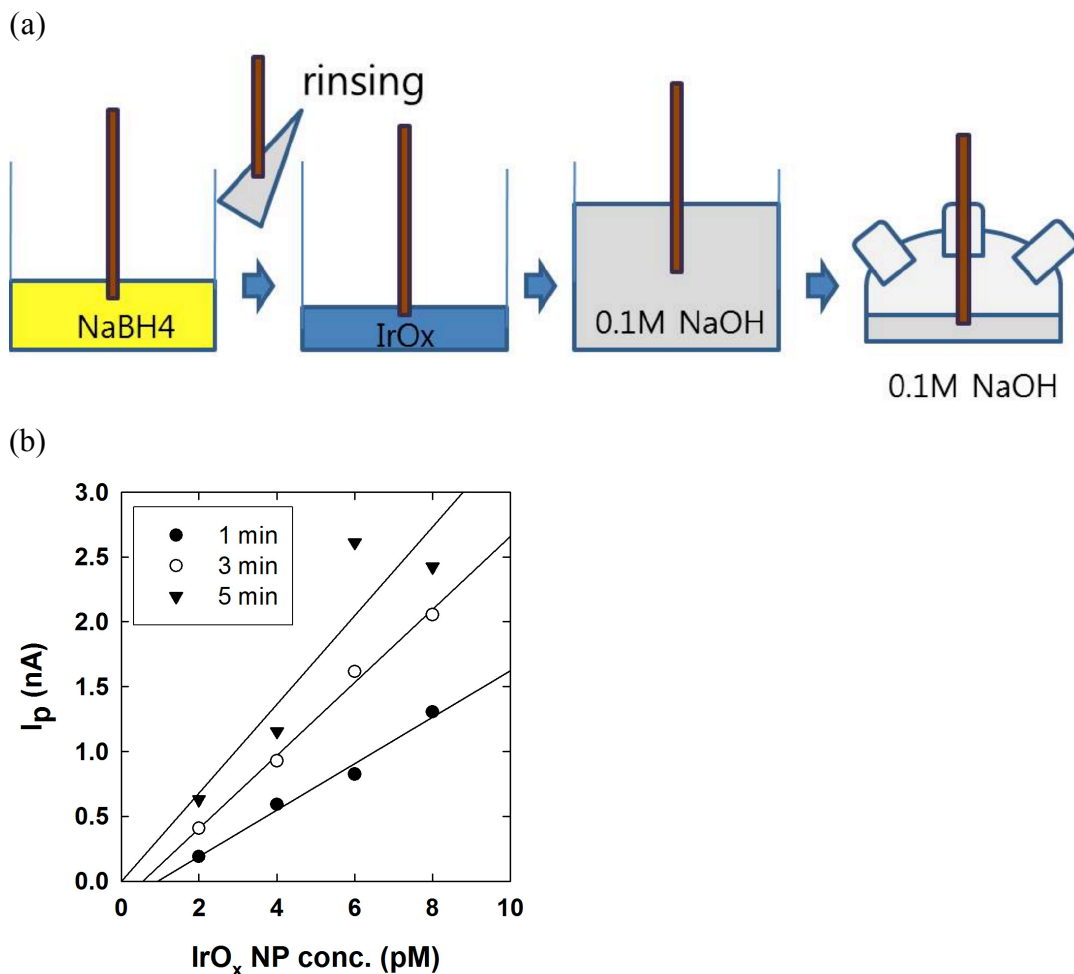


Figure S2. (a) Schematic illustration of pre-adsorption experiments (NaBH₄ treatment for 3 min → rinsing → immersing in IrO_x NP containing solution (1, 3, or 5 min) → washing in 0.1 M NaOH → electrochemical measurement in NP free solution) and (b) peak current (at ~ 0.7 V vs Ag/AgCl) for water oxidation with different immersion times before a voltammetric scan at Pt UME (radius 5 μm) in pH 13 solution (0.1 M NaOH) containing different concentrations of IrO_x NPs. (diameter 28 ± 4.8 nm) Scan rate, 50 mV/s.

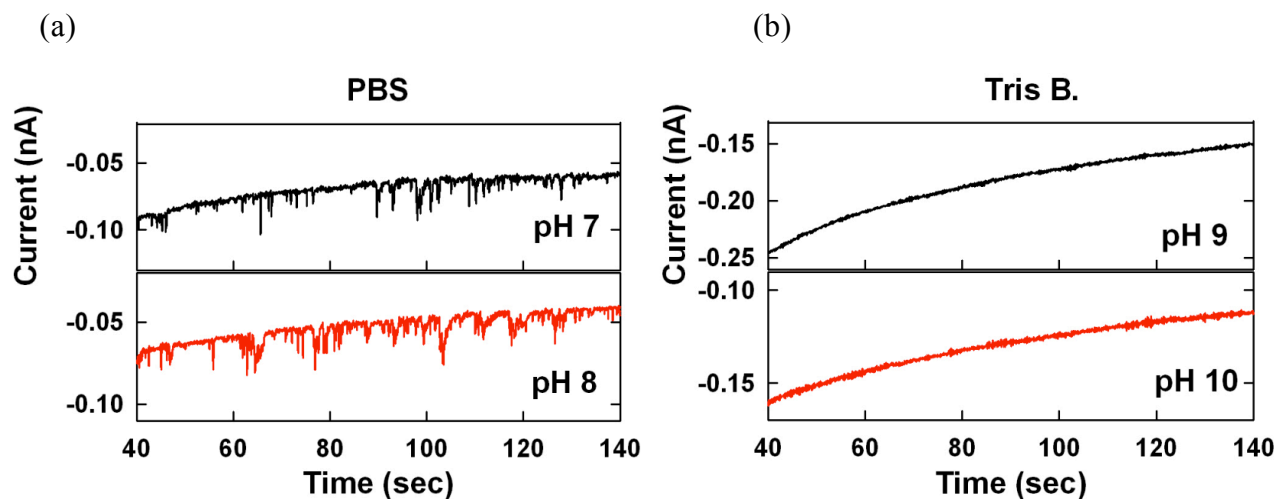


Figure S3. Chronoamperometric curves for single IrO_x NP collisions at the NaBH₄ treated Pt UME (radius 5 μm) in a PBS (pH 7-8) and tris (pH 9-10) buffer solution containing IrO_x NPs.

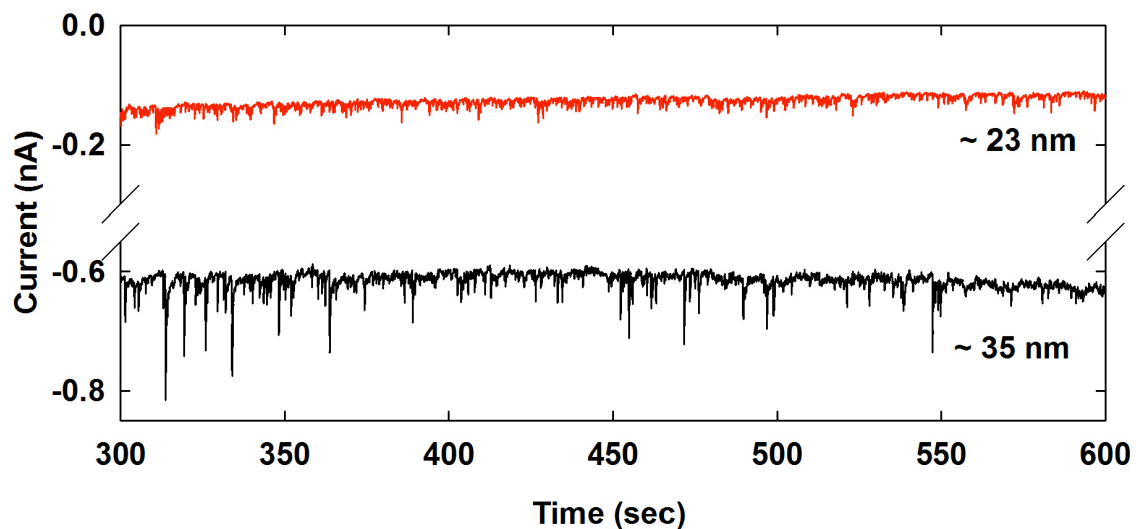
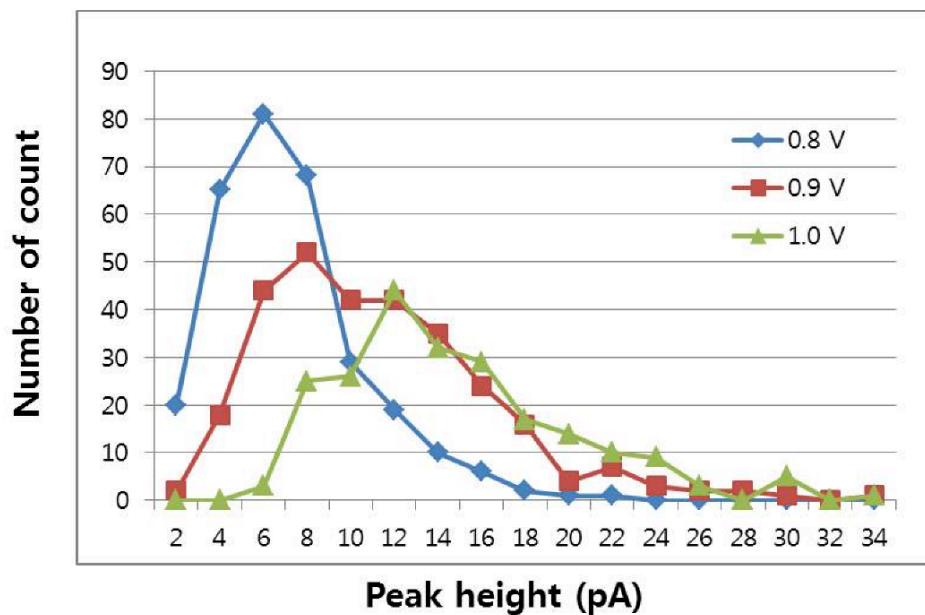


Figure 4. Peak height difference in chronoamperometric curves for single IrO_x NP collisions at the NaBH₄ treated Pt UME (radius 5 μm) using different size of IrO_x NP.



0.8 V (303 peaks), aver. height = 6.8 pA)
0.9 V (296 peaks), aver. height = 12.2 pA)
1.0 V (220 peaks), aver. height = 14.9 pA)

Figure S5. Peak height distribution in chronoamperometric curves for single IrO_x NP collisions at the NaBH₄ treated Pt UME (radius 5 μm) in a solution containing 4 pM IrO_x NPs of various applied potential from 0.8 V to 1.0 V (vs. Ag/AgCl). Data acquisition time is 50 ms.

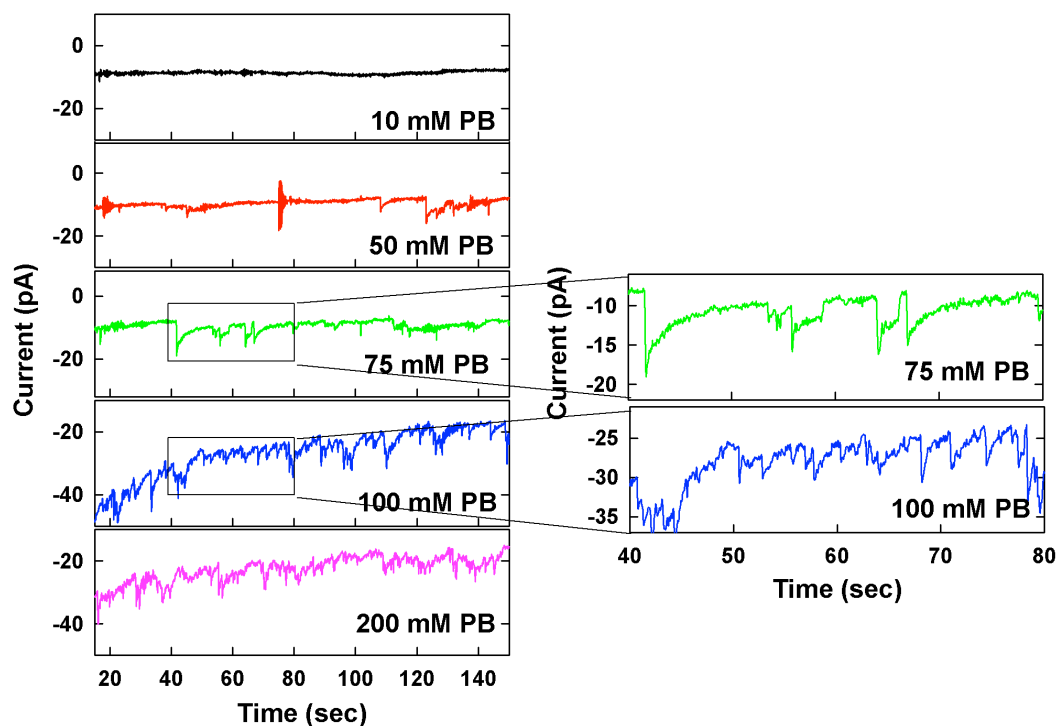


Figure S6. Chronoamperometric curves for single IrO_x NP collisions at the NaBH_4 treated Pt UME (radius $5 \mu\text{m}$) in a solution containing 2 pM IrO_x NPs and PB (pH 7) of various concentration of phosphate from 10 to 200 mM. Applied potential is 1.1 V (vs. Ag/AgCl). Data acquisition time is 50 ms.

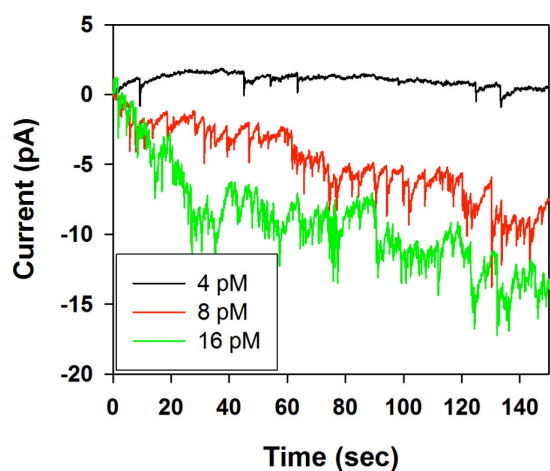


Figure S7. Chronoamperometric curves for single IrO_x NP collisions on the NaBH_4 treated Pt UME (radius $5 \mu\text{m}$) in a solution containing 4 pM (black), 8 pM (red), or 16 pM (green) IrO_x NPs, PB (pH 7, 75 mM), and 1.5 mM sulfite ion. Applied potential is 1.1 V (vs. Ag/AgCl). Data acquisition time is 50 ms.

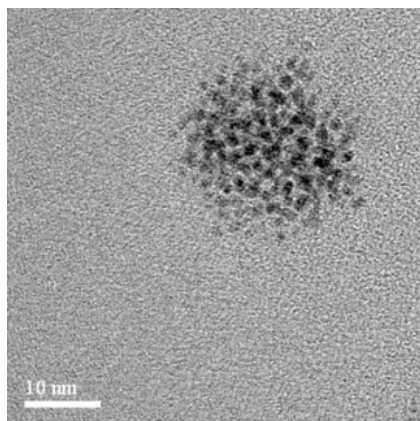


Figure S8. TEM image of an IrO_x nanoparticle. The IrO_x NP (average diameter 28 ± 4.8 nm) consisted of small (diameter ~ 1 nm) NPs.

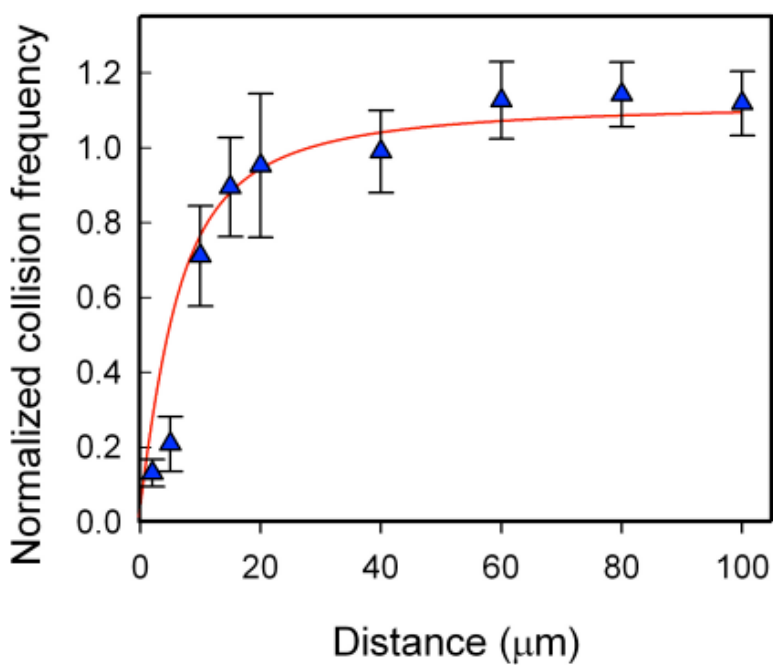


Figure S9. Experimentally obtained (blue triangle) normalized collision frequency in the presence of 0.5 mM sulfite ion containing solution as a function of distance between a tip and insulating surface. The red line is theoretical negative feedback approach curve. The radius of tip is $5 \mu\text{m}$ and RG is ~ 10 . Total data collecting time is 300 s (for 5 replicate measurements).