Supporting information

Toward the Continuous Production of Multigram Quantities of Highly Uniform Supported Metallic Nanoparticles and Their Application for Synthesis of Superior Intermetallic Pt-Alloy ORR Electrocatalysts

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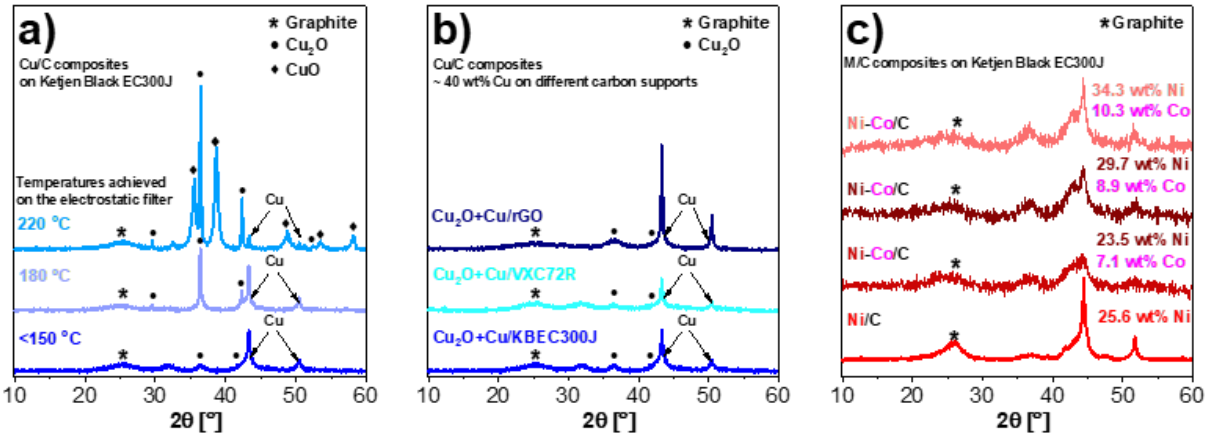

Figure S1. (a) XRD spectra comparison of Cu/C composites obtained at various temperatures at the electrostatic filter of the pulse combustion reactor. **(b)** XRD spectra comparison of Cu/C composites on various carbon-based supports prepared *via* the pulse combustion method. **(c)** XRD spectra comparison of Ni-Co composites (mix of two metals) with various metal loadings over carbon prepared *via* the pulse combustion method.[1]

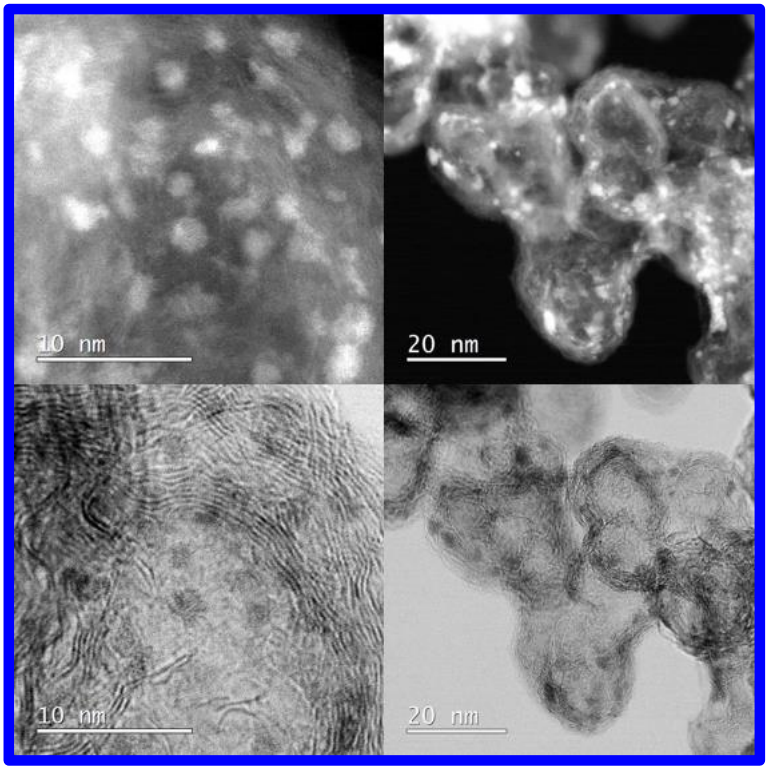

Figure S2. ADF and BF STEM images of Cu+Cu_2O/C (C = Ketjen Black EC300J) composite prepared *via* the pulse combustion method.[1]

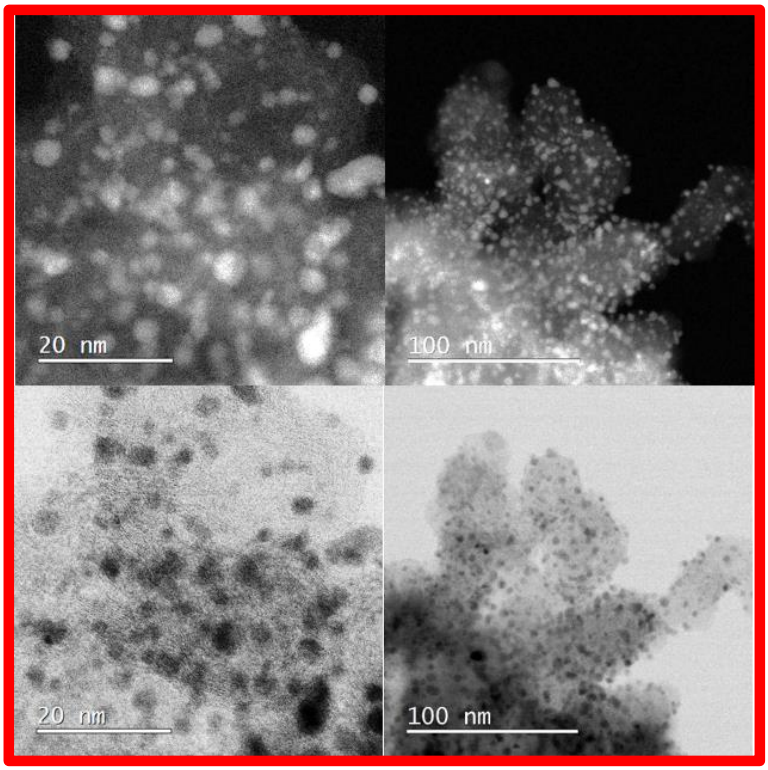

Figure S3. ADF and BF STEM images of Ni+NiO/C (C = Ketjen Black EC300J) composite prepared *via* the pulse combustion method.[1]

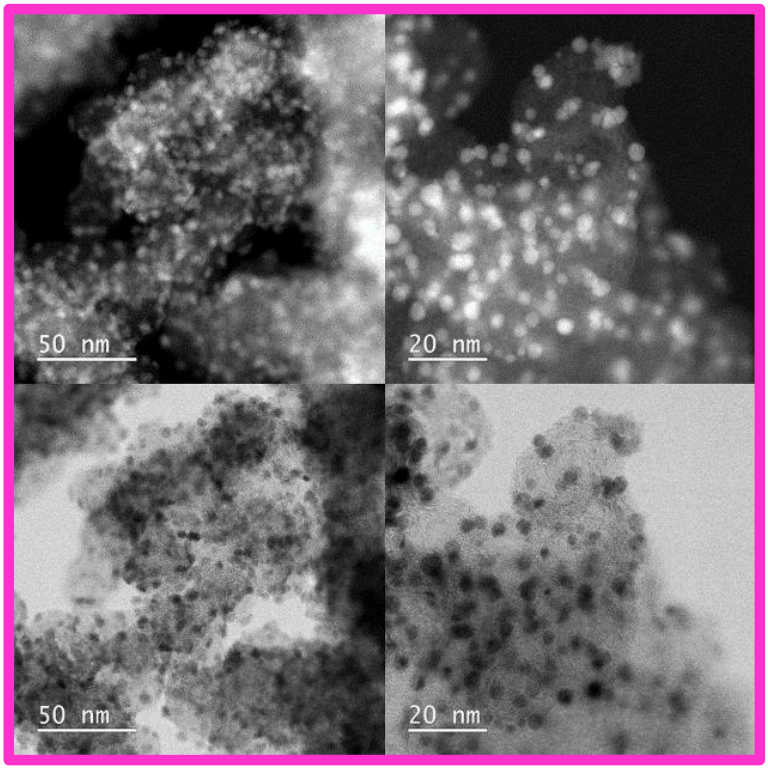

Figure S4. ADF and BF STEM images of Co+CoO/C (C = Ketjen Black EC300J) composite prepared *via* the pulse combustion method.[1]

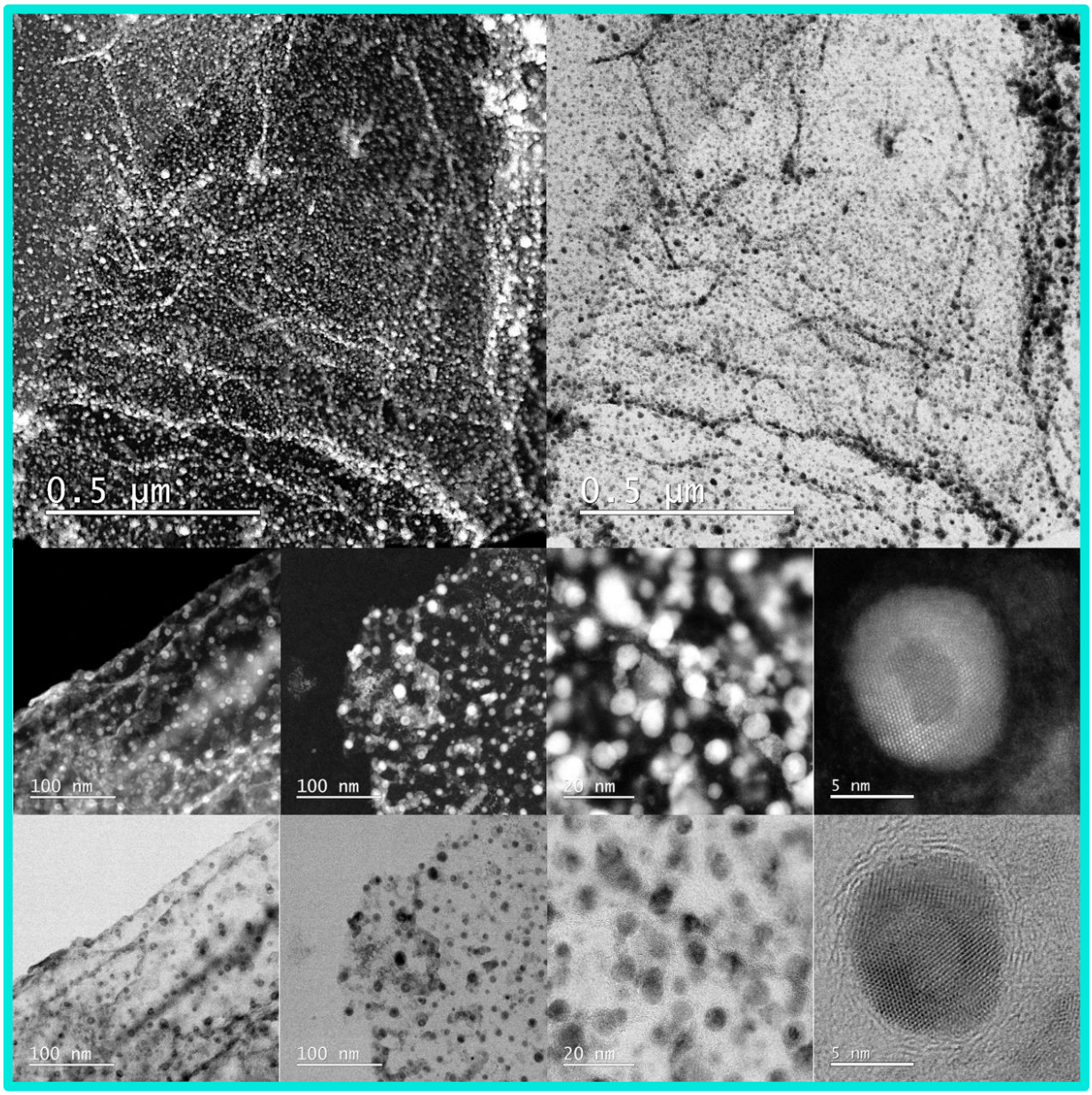

Figure S5. ADF and BF STEM images of Cu+Cu_2O/rGO composite prepared *via* the pulse combustion method.[1]

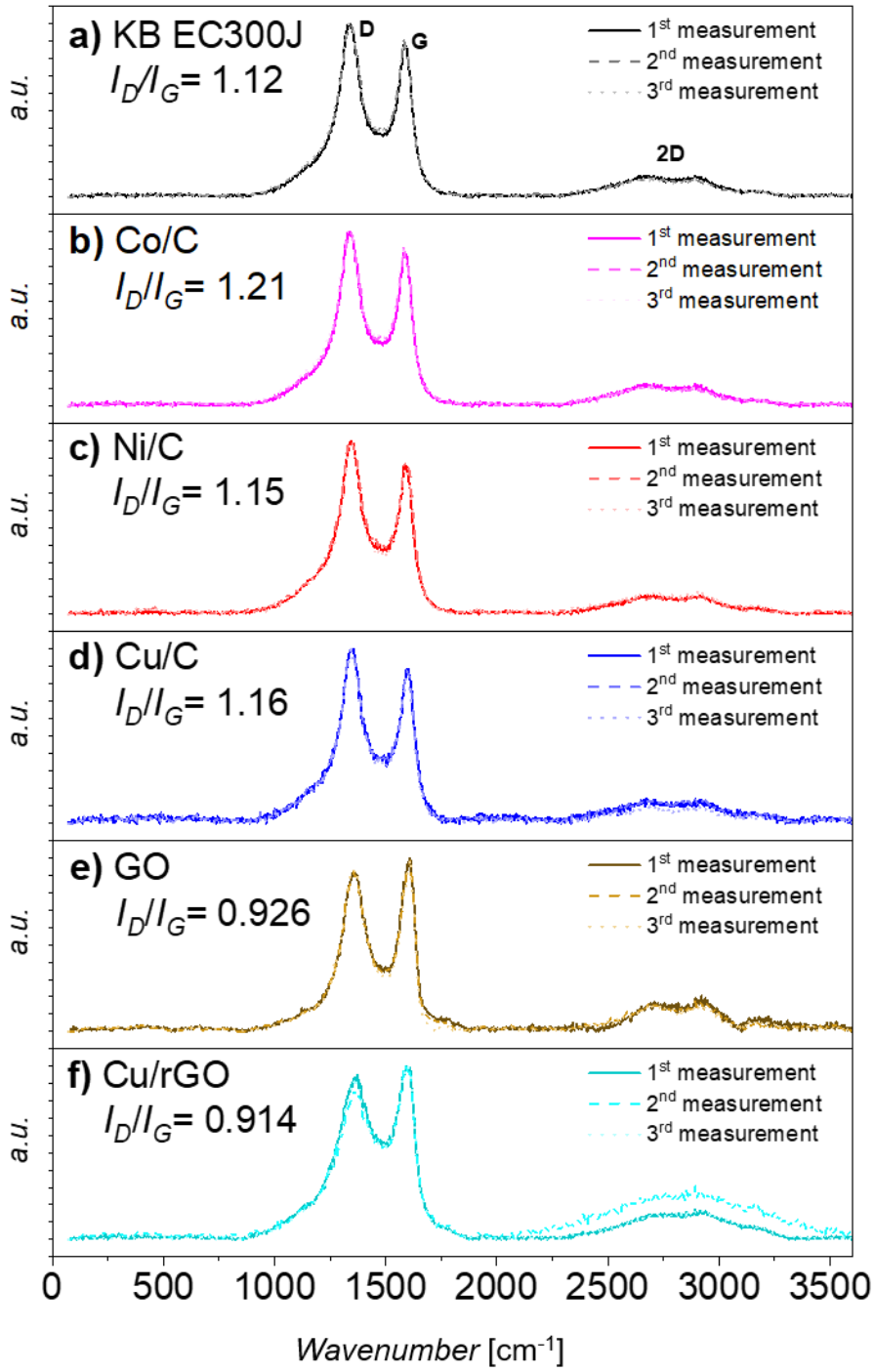

Figure S6. (a-f) Comparison of Raman spectra of starting carbon-based supports (Ketjen Black EC300J and GO) and corresponding M/C (M = Co, Ni and Cu) & M/rGO composites prepared *via* the pulse combustion method at 3 different locations for reproducibility.

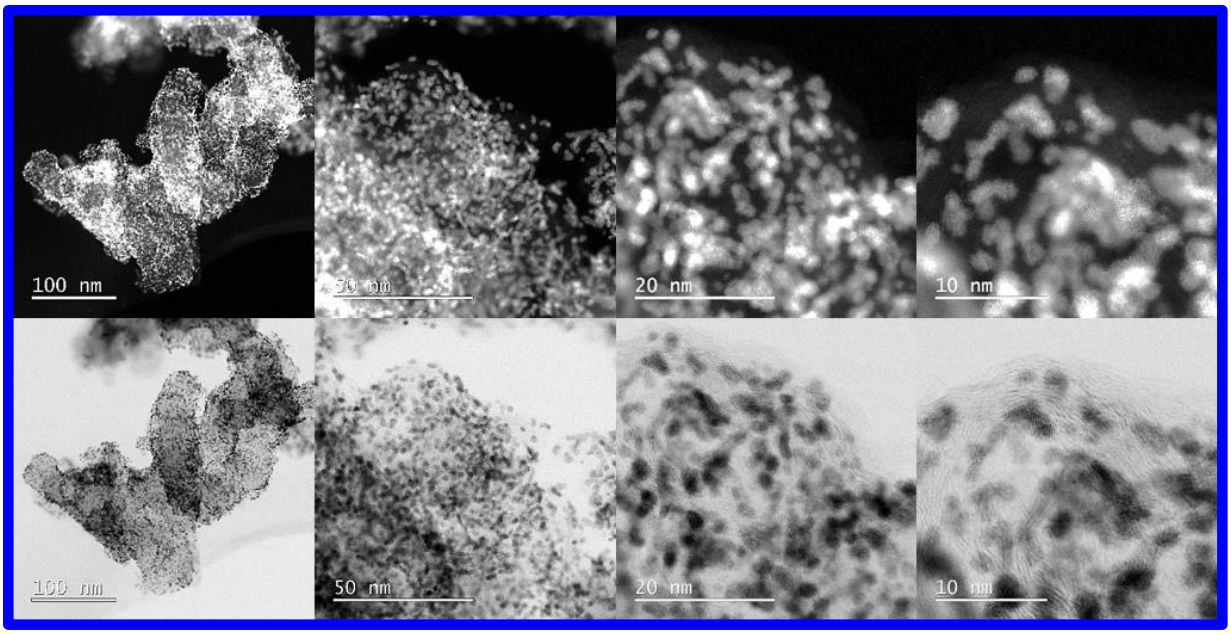

Figure S7. ADF and BF STEM images of PtCu+CuO/C (C = Ketjen Black EC300J) after Pt NP deposition step *via* GD method.[1]

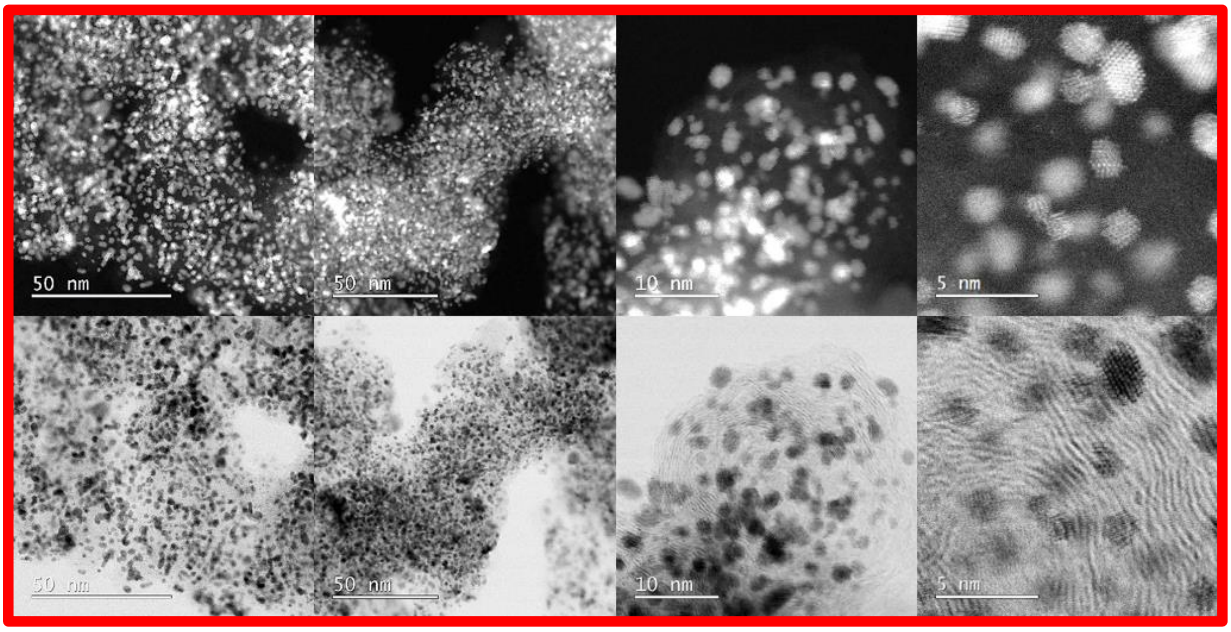

Figure S8. ADF and BF STEM images of Pt+Ni/C (C = Ketjen Black EC300J) after Pt NP deposition step *via* GD method.[1]

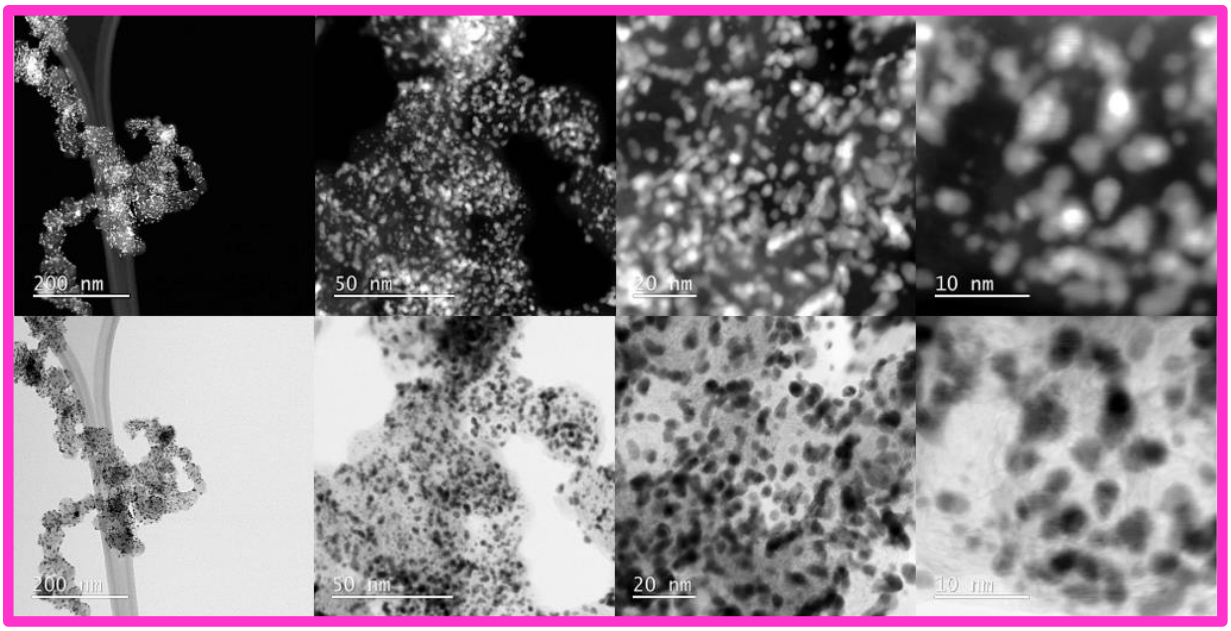

Figure S9. ADF and BF STEM images of Pt+Co/C (C = Ketjen Black EC300J) after Pt NP deposition step *via* GD method.[1]

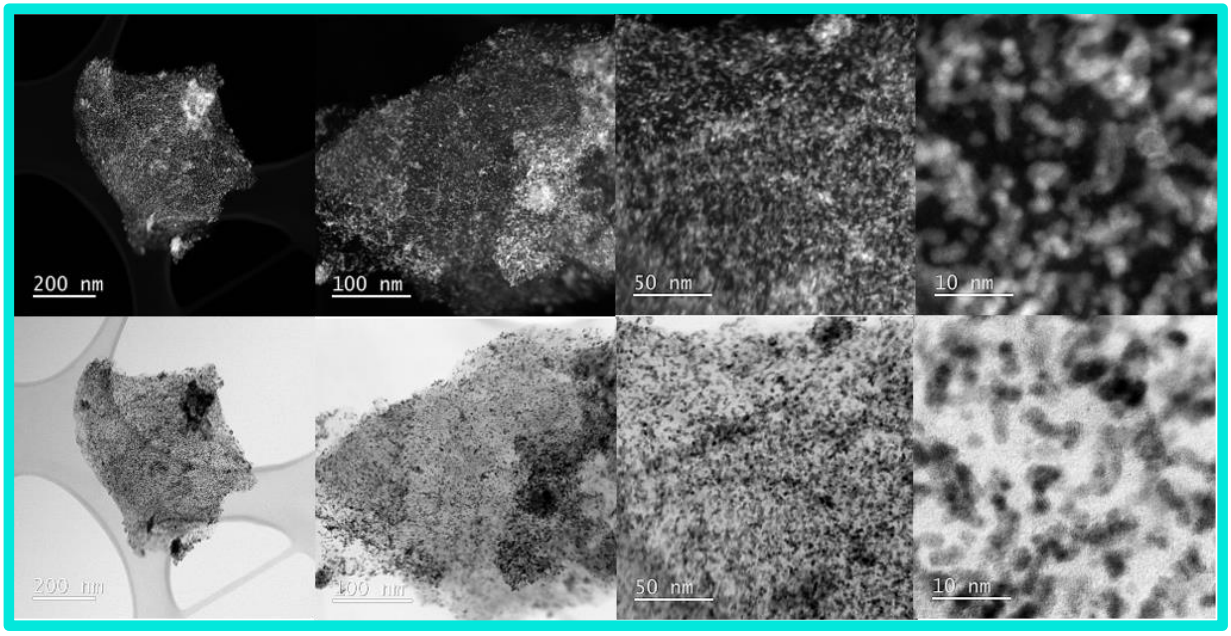

Figure S10. ADF and BF STEM images of PtCu+CuO/rGO after Pt NP deposition step *via* GD method.[1]

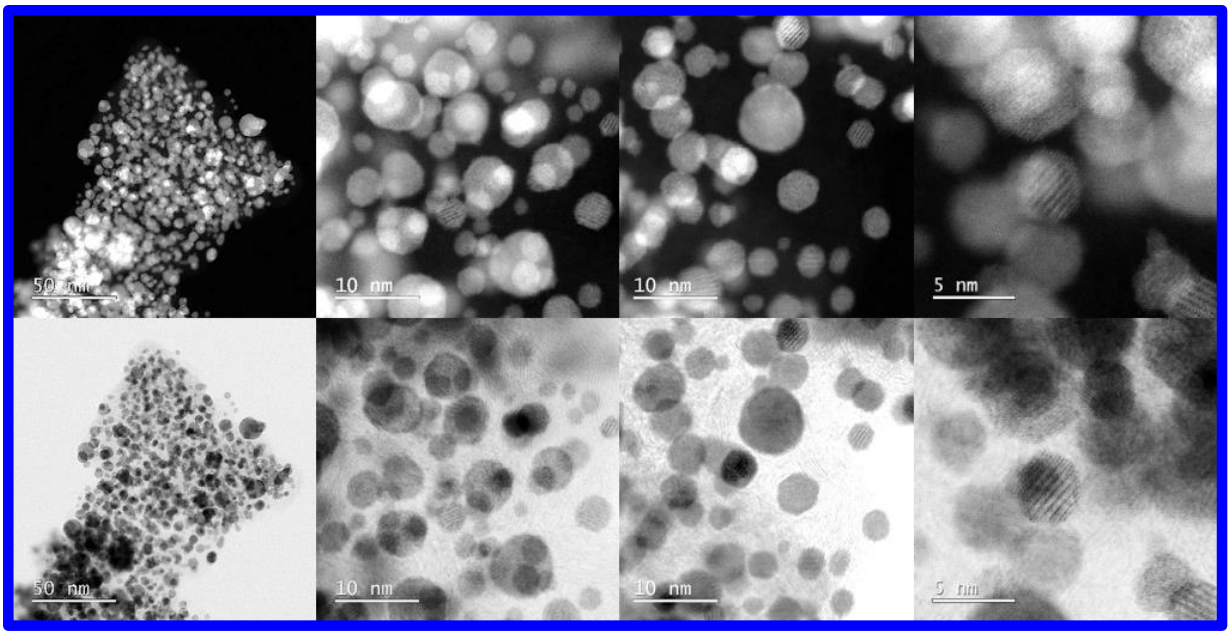

Figure S11. ADF and BF STEM imaging of d-int-Pt-Cu/C electrocatalyst.

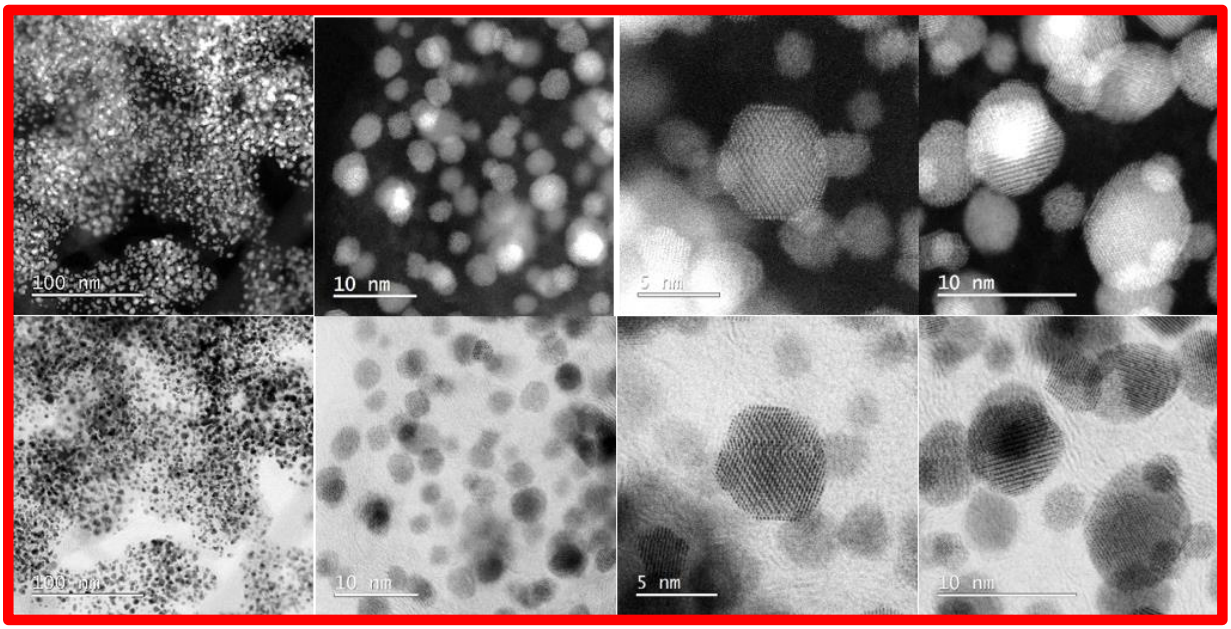

Figure S12. ADF and BF STEM imaging of d-int-Pt-Ni/C electrocatalyst.

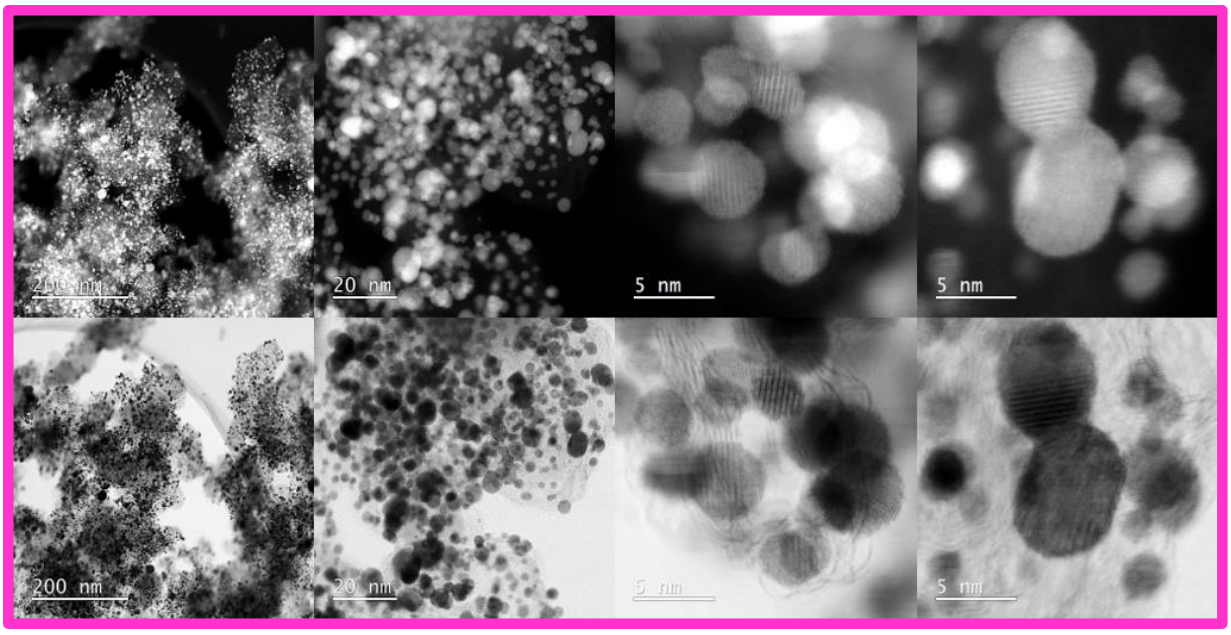

Figure S13. ADF and BF STEM imaging of d-int-Pt-Co/C electrocatalyst.

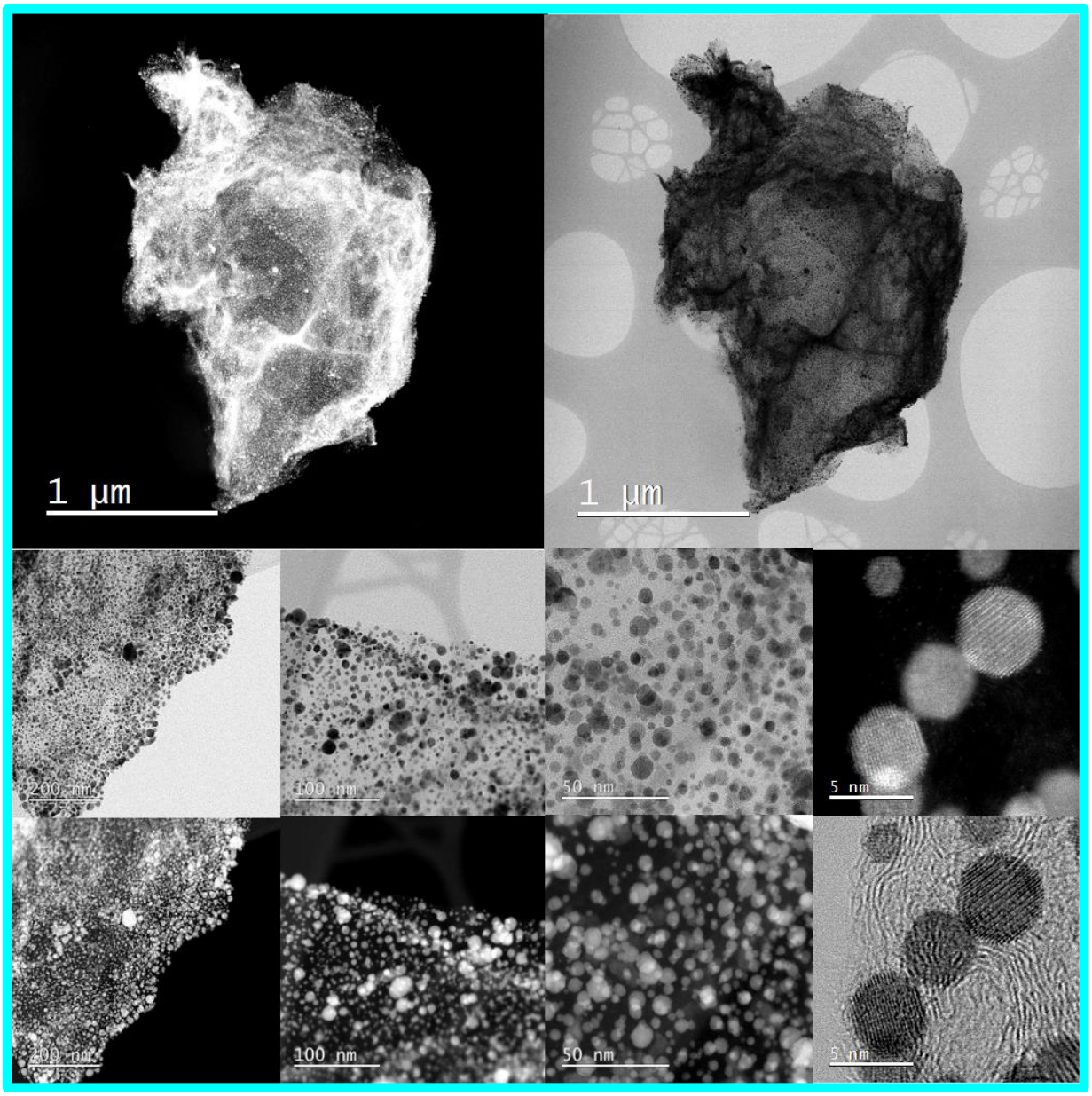

Figure S14. ADF and BF STEM imaging of d-Pt-Cu/C-rGO electrocatalyst.

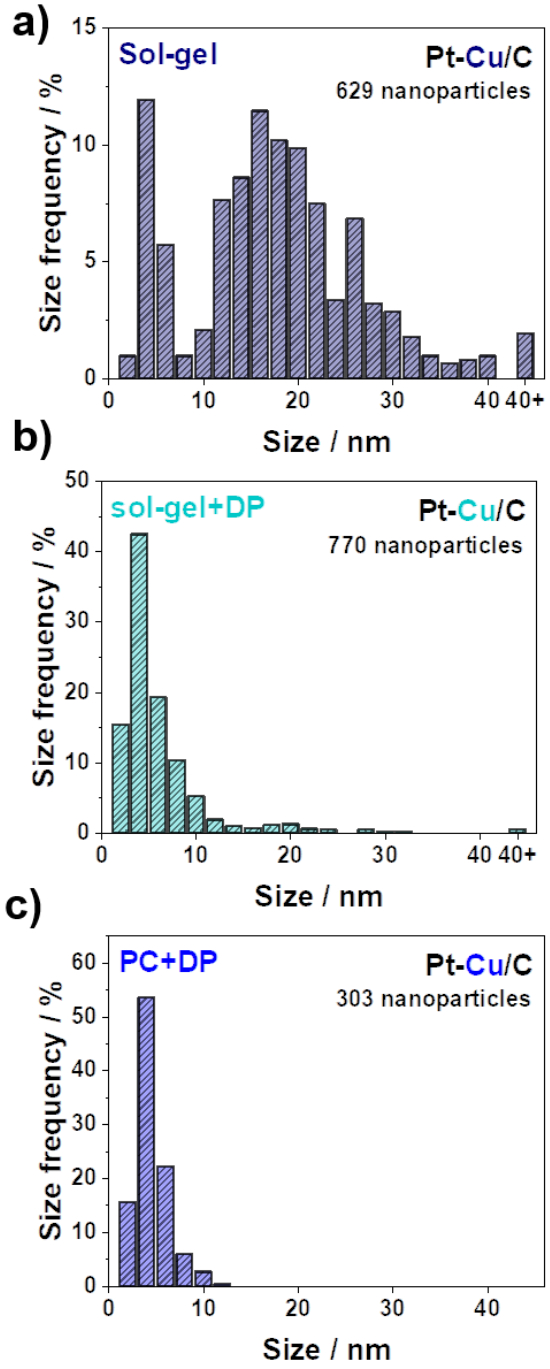

Figure S15. Particle size distribution improvement in the dispersion of Pt-M NPs over carbon upon transitioning from **(a)** sol-gel method for preparation of M/C composites with conventional galvanic displacement for deposition of Pt NPs,[2–5] **(b)** combining sol-gel for preparation of M/C composites with DP method for Pt NP deposition[1,6] and **(c)** utilizing the synergy between PC methodology for the production of M/C composites in combination with DP method for Pt NP deposition (this work).[1,6]

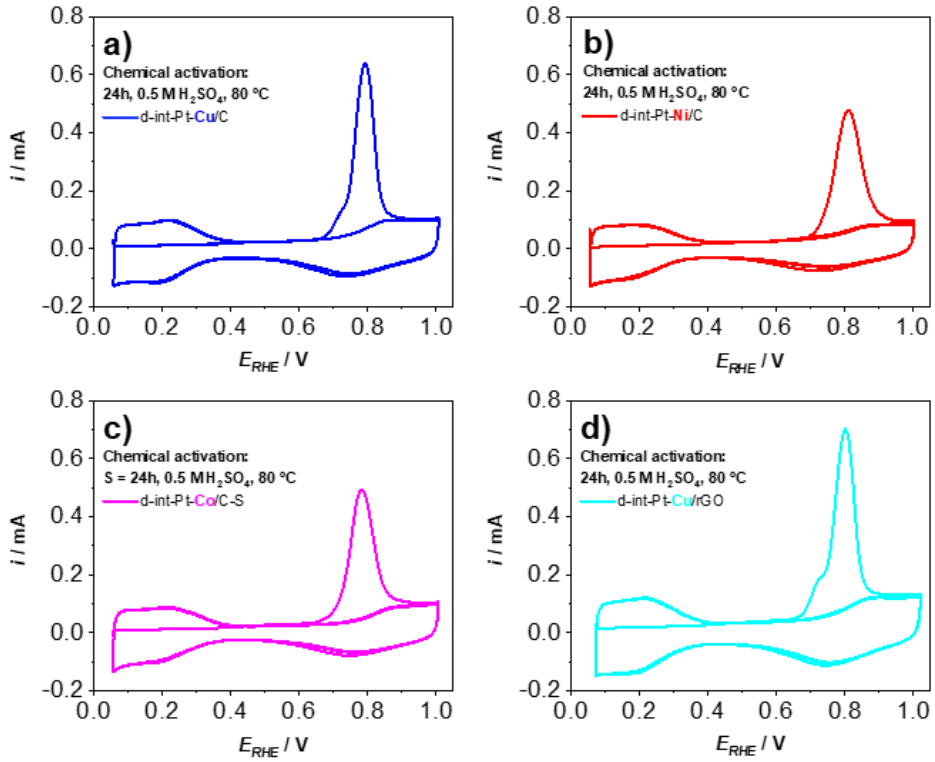

Figure S16. CO-electrooxidation CVs (0.05-1.0 V_{RHE}, 20 mV s^{-1}, no rotation, 0.1 M $HClO_4$, Ar saturated after CO_g adsorption) of **(a)** d-Pt-Cu/C-S, **(b)** d-Pt-Ni/C-S, **(c)** d-Pt-Co/C-S and **(d)** d-Pt-Cu/rGO-S electrocatalysts.

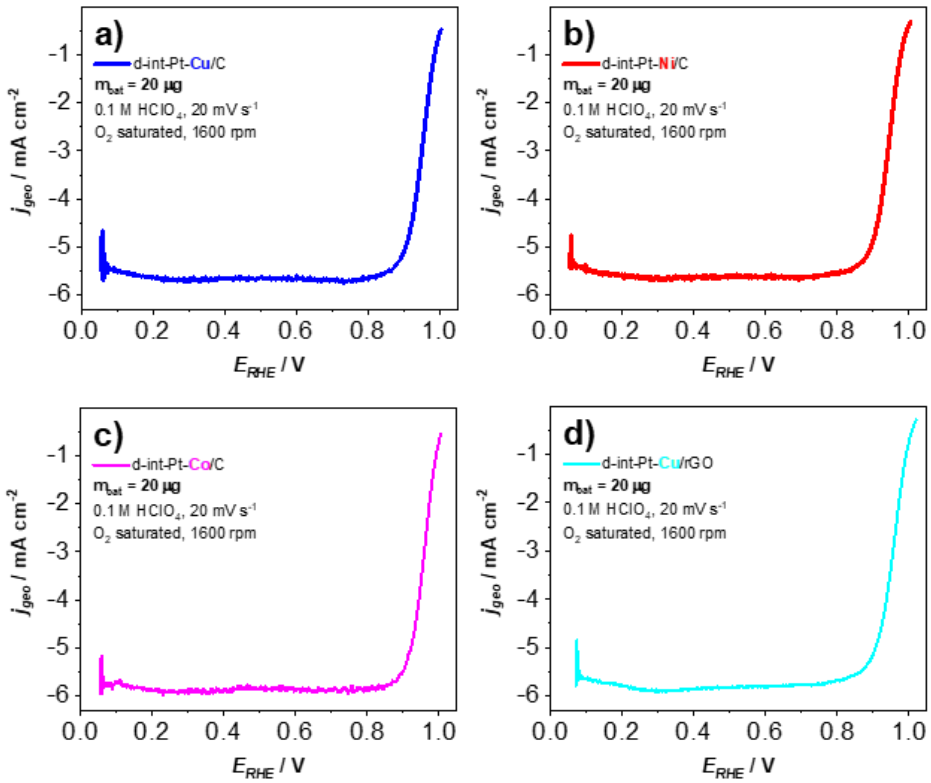

Figure S17. ORR polarization curves (0.05-1.0 V_{RHE}, 20 mV s^{-1}, 1600 rpm, iR and background corrected, 0.1 M $HClO_4$, O_2 saturated) of **(a)** d-Pt-Cu/C-S, **(b)** d-Pt-Ni/C-S, **(c)** d-Pt-Co/C-S and **(d)** d-Pt-Cu/rGO-S electrocatalysts.

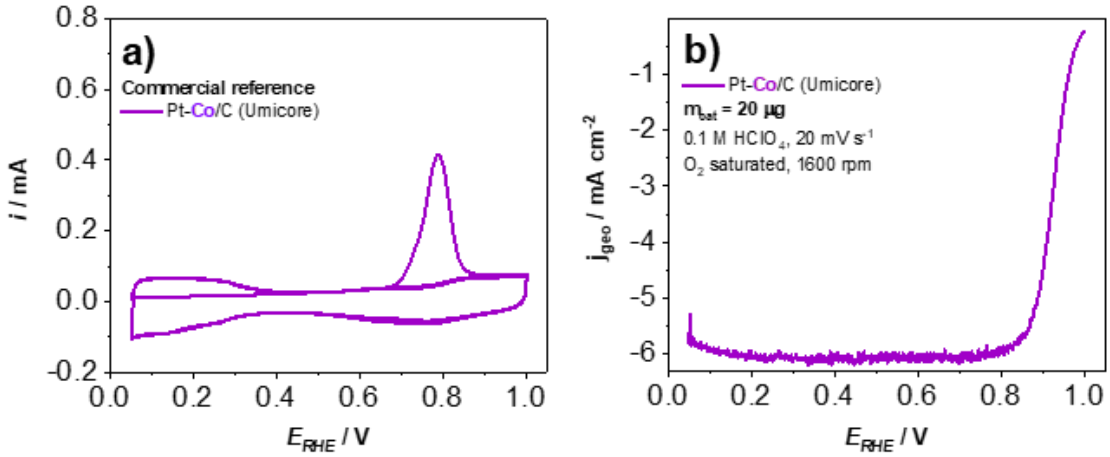

Figure S18. CO-electrooxidation CV (0.05-1.0 V_{RHE}, 20 mV s^{-1}, no rotation, 0.1 M $HClO_4$, Ar saturated after CO_g adsorption) and ORR polarization curve (0.05-1.0 V_{RHE}, 20 mV s^{-1}, 1600 rpm, iR and background corrected, 0.1 M $HClO_4$, O_2 saturated) of Pt-Co/C electrocatalyst from Umicore (Elyst Pt30 0690) with 27 wt% Pt and approximately 3 wt% Co.

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