

Supplementary information for
Copper-Palladium/Reduced Graphene Oxide Composite as a Catalyst for the Oxygen
Reduction Reaction

*Vasiliy Brusko,^{a,b} Anna Prytkova,^{a,b} Maria Kirsanova,^c Iskander Vakhitov,^d Aigul Sabirova,^{b,e}
Dmitrii Tayurskii,^d Marsil Kadirov,^{b,e*} and Ayrat M. Dimiev^{a,b*}*

^aLaboratory for Advanced Carbon Nanomaterials, Kazan Federal University, Kremlevskaya st. 18, Kazan, Russian Federation, 420008

^bLaboratory “Materials for Green Energy and Sustainability”, Kazan Federal University, Kremlevskaya st. 18, Kazan, Russian Federation, 420008

^cAdvanced Imaging Core Facility, Skolkovo Institute of Science and Technology, 121205 Moscow, Russian Federation

^dInstitute of Physics, Kazan Federal University, Kremlevskaya st. 18, Kazan, Russian Federation, 420008

^eArbuzov Institute of Organic and Physical Chemistry, FRC Kazan Scientific Center, Russian Academy of Sciences, Kazan, Russian Federation 420088

**Corresponding author: E-mail: AMDimiev@kpfu.ru (Ayrat Dimiev), and kamaka59@gmail.com (Marsil Kadirov)*

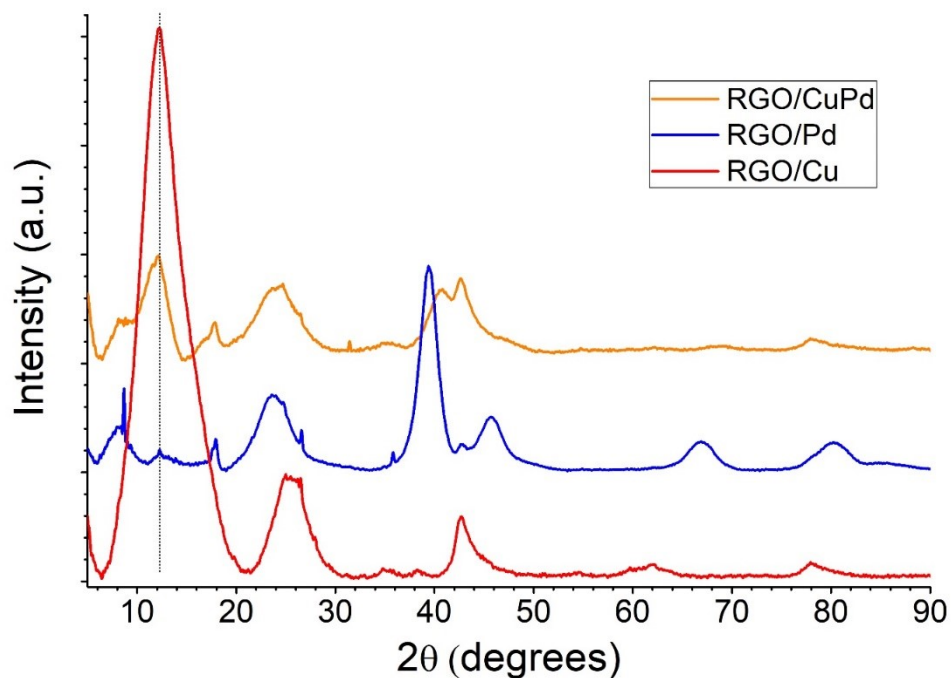


Figure S1. XRD patterns of the three RGO/metal composites.

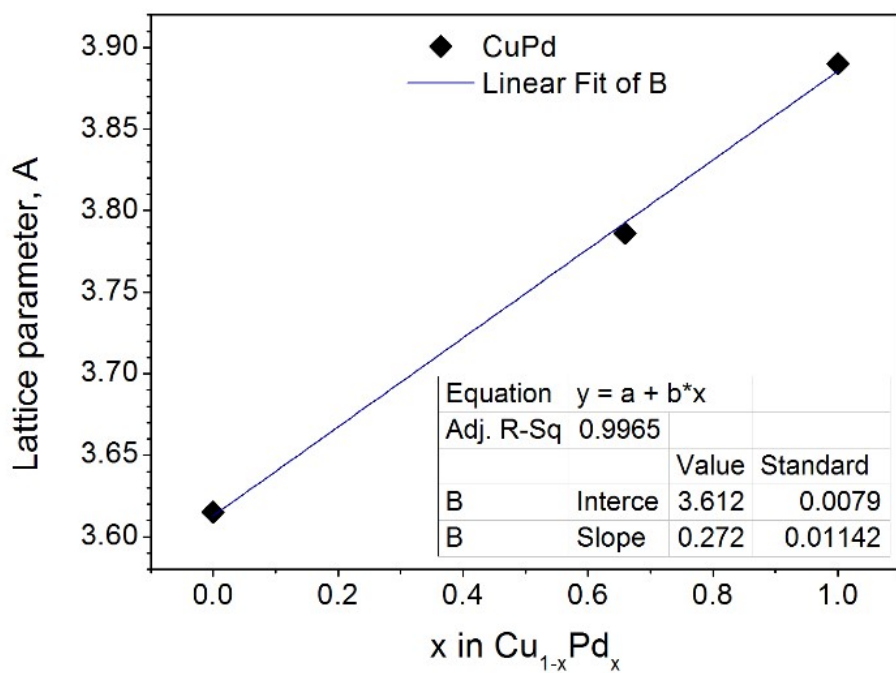


Figure S2. The lattice parameter a versus atomic fraction x for the $\text{Cu}_{1-x}\text{Pd}_x$ alloy (black diamonds) and the linear fit (blue line). The parameters of linear fit are given as inset.

* The lattice parameters $a = 3.615 \text{ \AA}$ and 3.890 \AA for metallic Cu and Pd, respectively, were taken from the PDF2 powder X-ray diffraction database (card numbers [4-836] and [46-1043]). The lattice parameter $a = 3.78 \text{ \AA}$ of CuPd alloy was calculated from XRD data in Fig. 1, orange curve.

Table S1. The results of quantitative STEM-EDX analysis for mixed CuPd nanoparticles in RGO/CuPd composite.

Element	Line Family	Atomic Fraction (%)				Average	St. deviation
		1	2	3	4		
Cu	K	28.68	32.78	31.82	42.99	34	6
Pd	L	71.32	67.22	68.18	57.01	66	6

Table S2. The results of quantitative STEM-EDX analysis, showing the **overall** Cu and Pd mass fractions in RGO/CuPd composite.

Element	Line Family	Mass Fraction (%)			Average	St. deviation
		1	2	3		
Cu	K	50.35	39.69	32.91	45	8
Pd	L	49.65	60.31	67.09	55	8

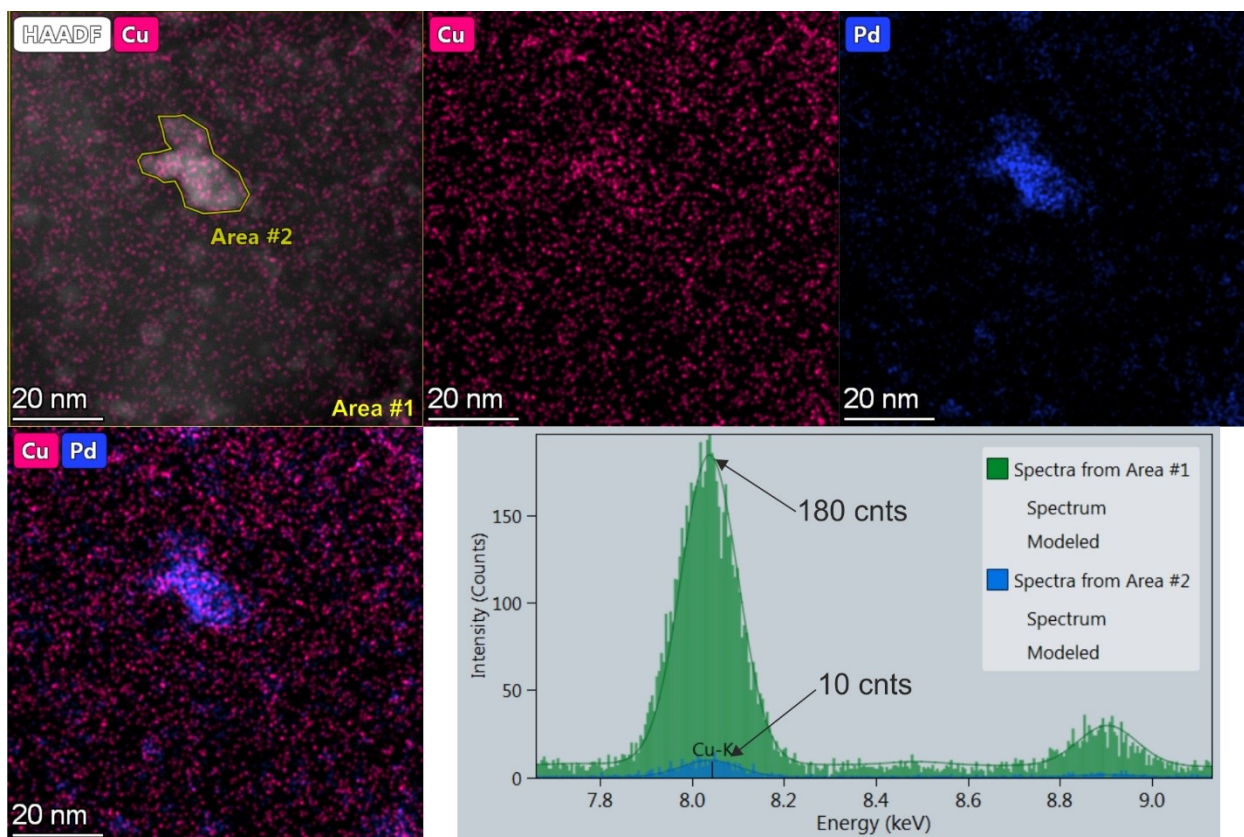


Figure S3. Individual and mixed compositional EDX maps of RGO/CuPd composite. EDX spectra taken from the whole field of view and CuPd nanoparticle show the difference in the intensity of Cu-K lines.

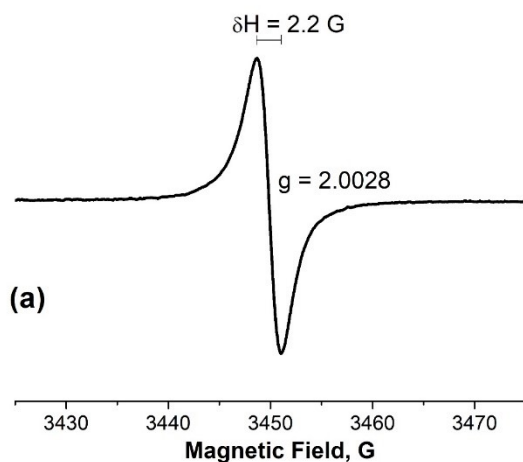


Figure S4. EPR spectrum for GO

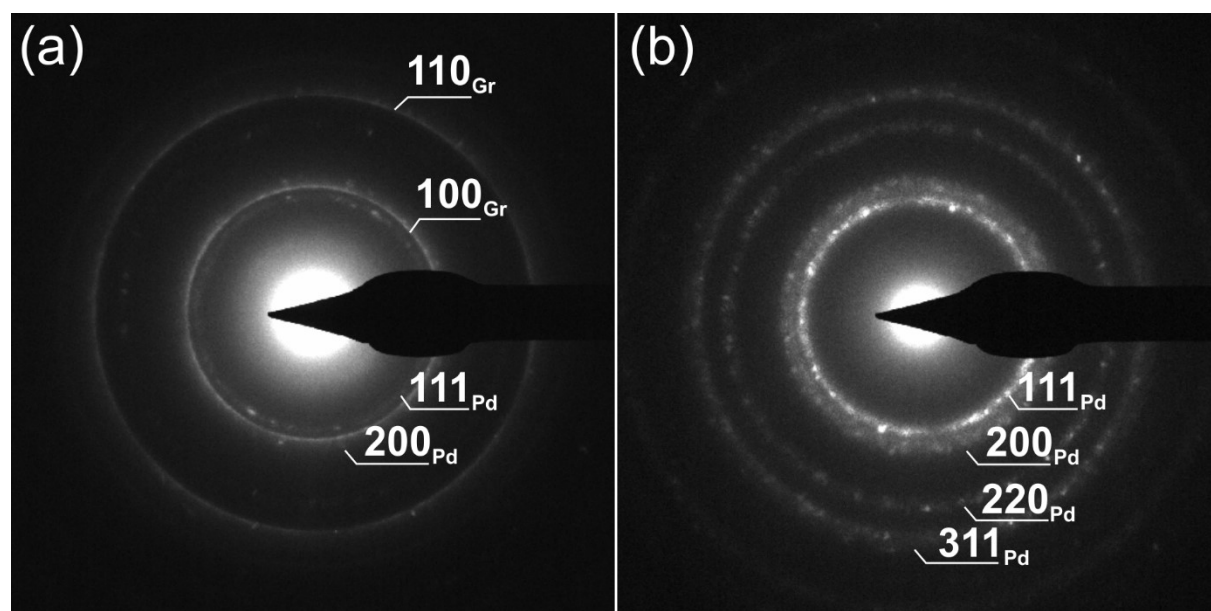


Figure S5. Electron diffraction pattern for RGO/Pd, acquired from the two different areas of the same RGO/Pd flake. (a) The regular area, evenly covered by individual Pd-NPs. (b) The area with the agglomeration of Pd-NPs.

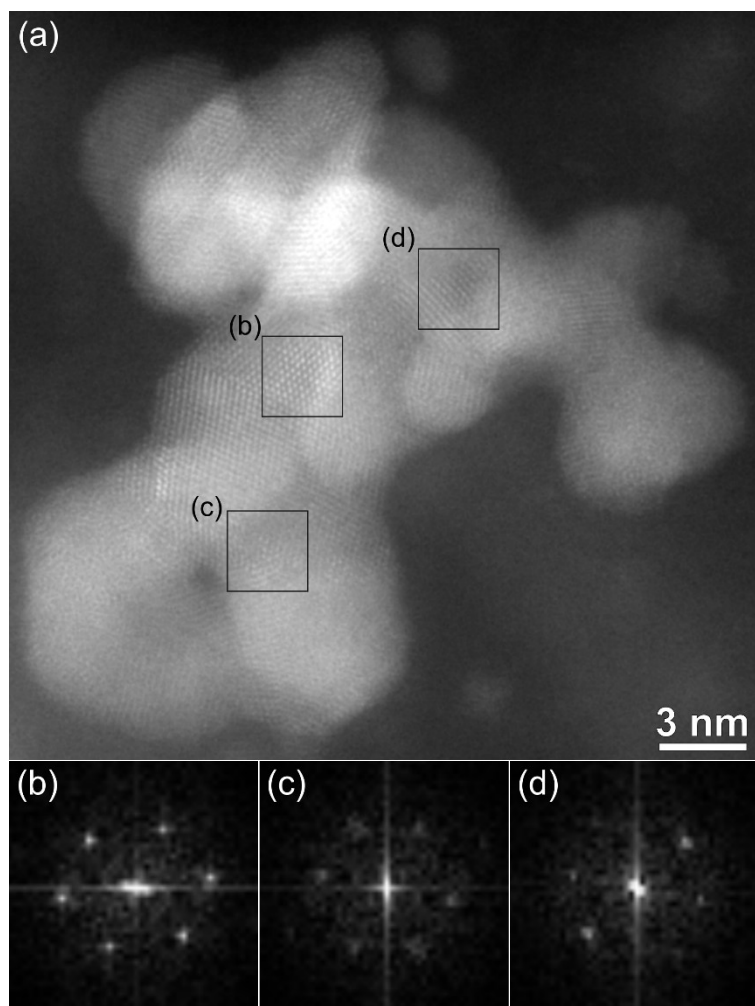


Figure S6. HAADF-STEM image of RGO/CuPd (a), and Fourier transform patterns from the areas, labeled by respective letters (b-d).