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New Cu_xS_y/S-doped nanoporous carbon composites as efficient oxygen reduction catalysts in alkaline medium

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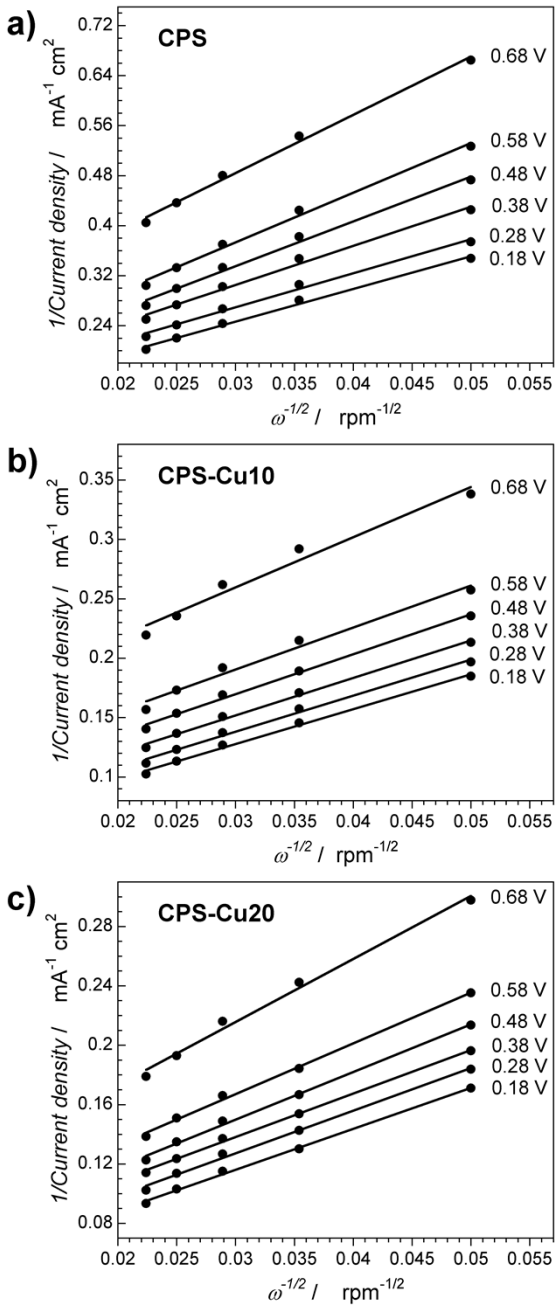

Fig. S1. Koutecky–Levich (K-L) plots for the (a) polymer-derived carbon, (b and c) copper/carbon composites at different potential values.

Nature of the ORR process on a Pt surface is complicated and not well understood. Under common ORR conditions, O_2 may be converted into different intermediates, such as oxygenated (O*), hydroxyl (OH*) and superhydroxyl (OOH*) species. That might be a reason in the different current density and number of electron transfer.[1, 2]

Table S1. Summary of performance of commercial Pt/C catalyst in 0.1 M KOH at 1600 rpm:

Authors	Catalyst	Kinetic current density (mA cm^{-2})	Scan rate (mV s^{-1})	Number of electron transfer, average
Balan[3]	Pt/C	4.1	5	NA
Palaniselvam[4]	20 wt% Pt/C (E-TEK)	5.2	5	NA
Wu[5]	20 wt% Pt Vulcan XC-72	~6.0	10	3.9
Zheng[6]	Pt/C	~4.0	5	3.8
Zhang[7]	20 wt% Pt/carbon black	4.0	10	NA
Lee[8]	20 wt% Pt Vulcan XC-72	4.5	10	~3.7
An[9]	20 wt% Pt/C	~5.2	10	4.0
Jiang[10]	20 wt% Pt/C	4.6	10	~3.7
Zhang[11]	20 wt% Pt/C	~5.0	10	NA
Liang[12]	20 wt% Pt Vulcan XC-72	~10.5	100	4.0
Our work	20 wt% Pt Vulcan XC-72	4.7	5	3.6

NA- not available

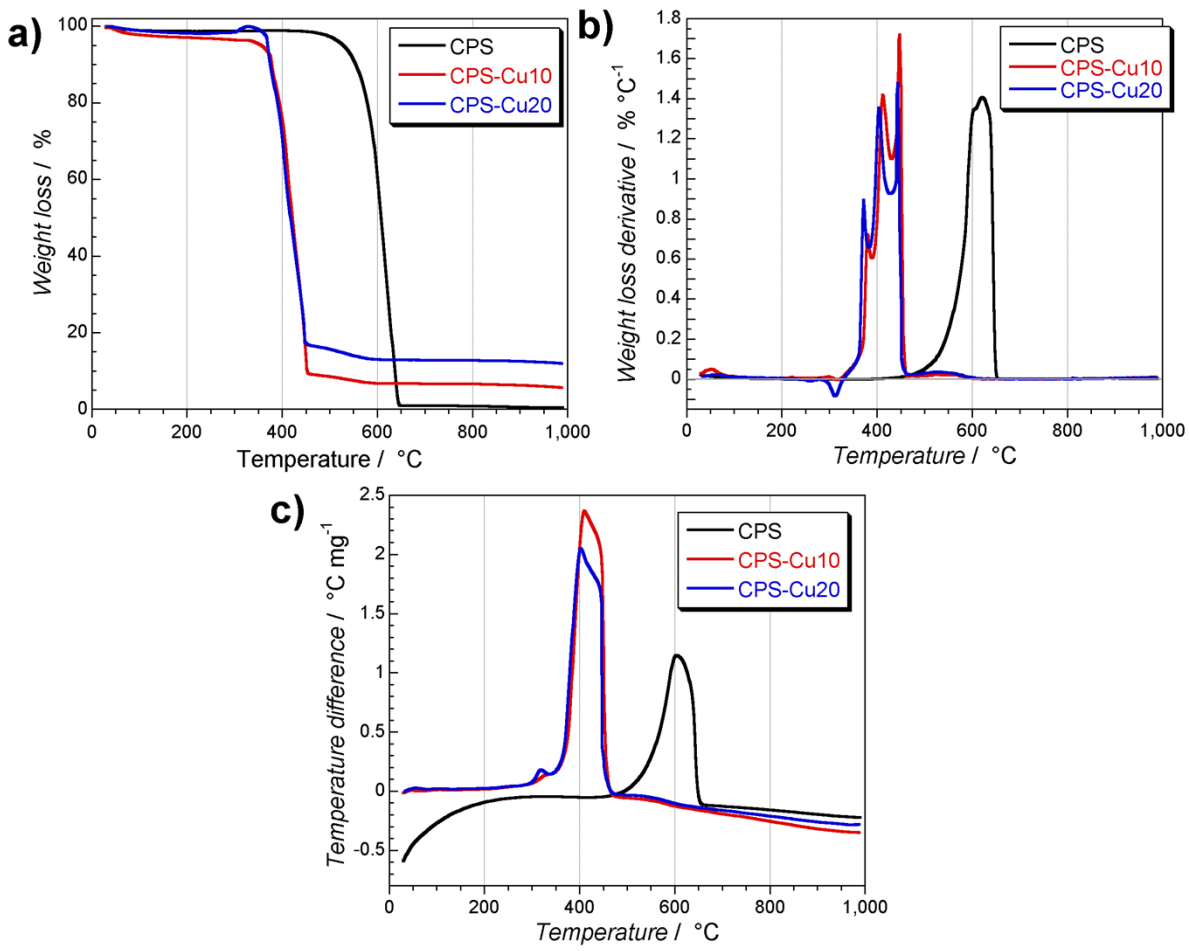

Fig. S2. a) Thermal Gravimetry (TG) curves; b) Differential Thermal Gravimetry (DTG) curves and c) Differential Thermal Analysis (DTA) curves in air for the materials studied.

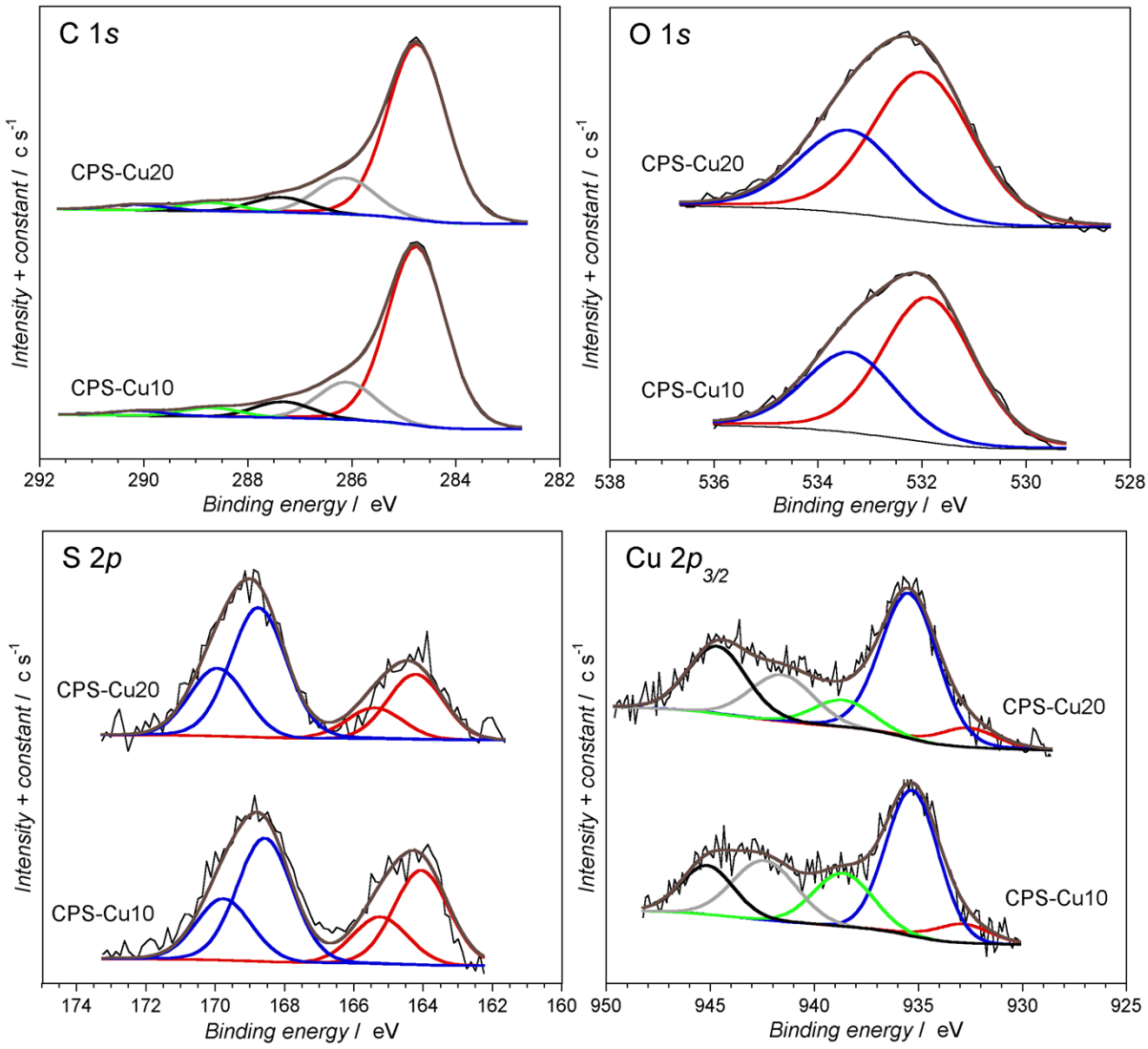

Fig. S3. C 1*s*, O 1*s*, S 2*p* and Cu $2p_{3/2}$ core level peaks of XPS spectra for the carbon/graphene/copper composites.

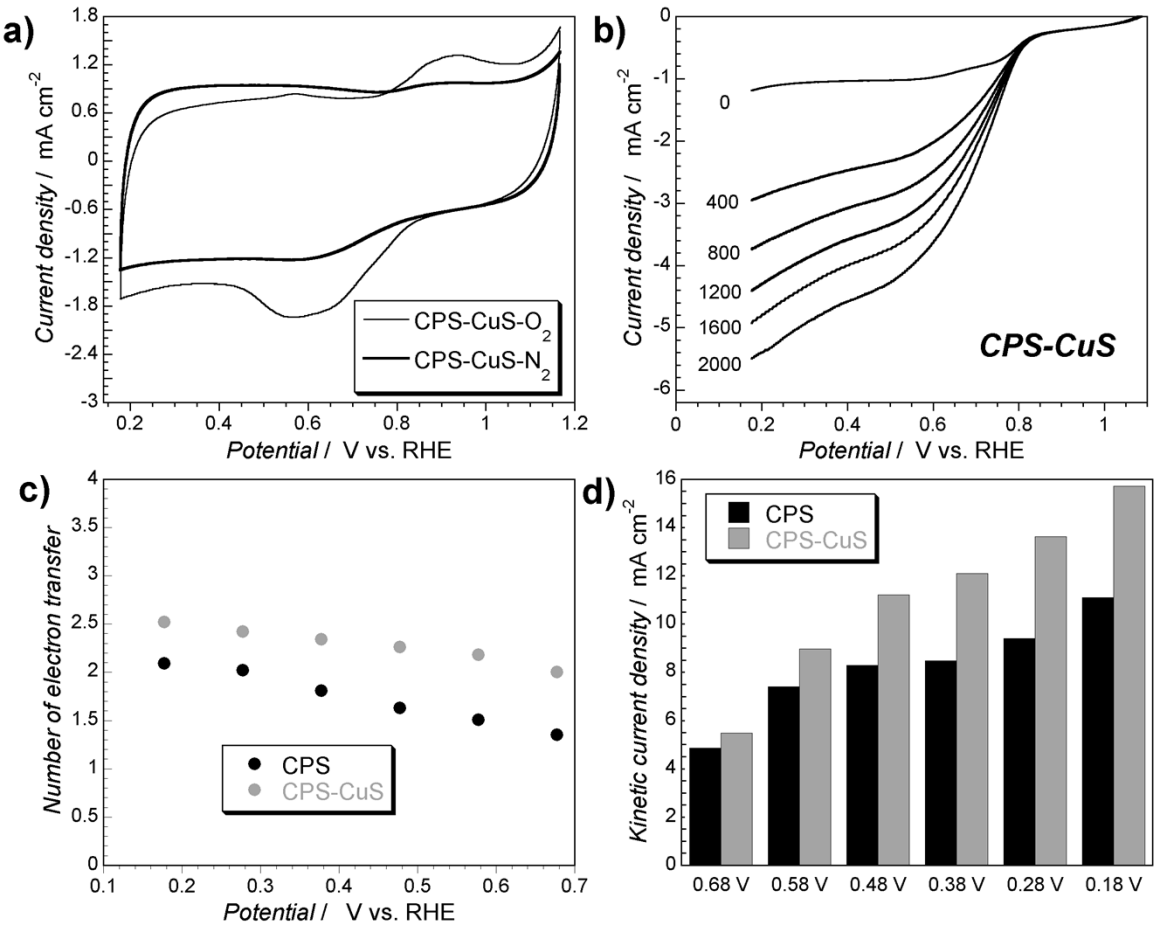

Fig. S4. (a) Cyclic voltammograms; (b) Linear sweep voltammograms on modified glassy carbon RDE in air-saturated 0.1 M KOH at scan rate of 5 mV s^{-1} for the physical mixture of polymer-derived carbon (CPS) with a 2 wt. % of CuS; (c) number of electron transfer versus potential and (d) comparison of the kinetic current density.

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