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# Electrical polymerization of a tetrazole polymer-modified electrode and its catalytic reaction toward dopamine

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### A B S T R A C T

A conducting polymer-modified electrode was proposed in this article, which was fabricated by electropolymerization of 5-amino-1H-tetrazole (ATet) on a glassy carbon electrode. Electrochemical studies such as differential pulse voltammetry and chronoamperometry were performed for the evaluation of the rate constant of the catalytic reaction, the diffusion coefficient of the analyte dopamine, and the linear dynamic range of the analyte determination. The film modified electrode has superior resolving power in quantitative determination from the mixture of analytes and it was found to be an efficient functionalized electrode for its sensitivity and selectivity toward the analyte of interest.

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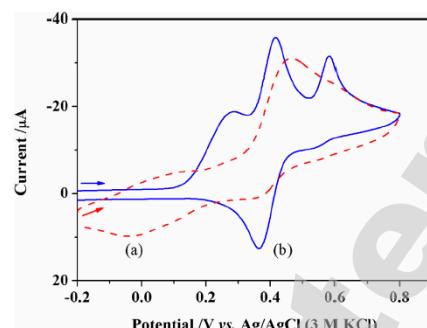
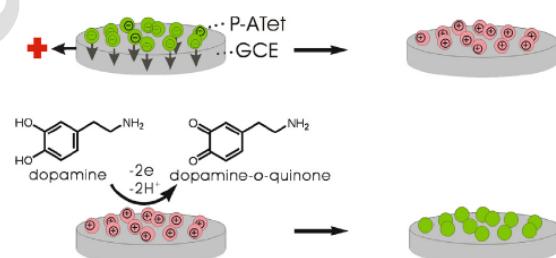


Fig. 8. Merged cyclic voltammograms of the aqueous solution containing 0.1 M KCl, ascorbic acid, dopamine, and uric acid on a bare GC electrode (a; red dashed curve) and the p-ATet modified GC electrode (b; blue solid curve) at a scan rate of  $50 \text{ mV s}^{-1}$ . (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)



Scheme 2. Illustration of the catalytic oxidation of dopamine by p-ATet.

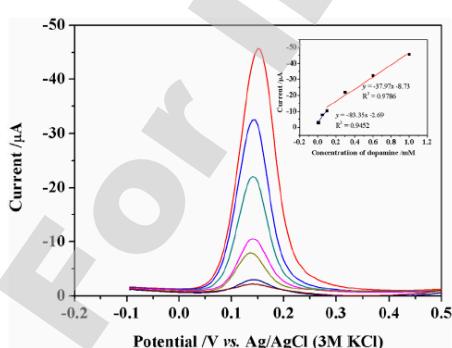
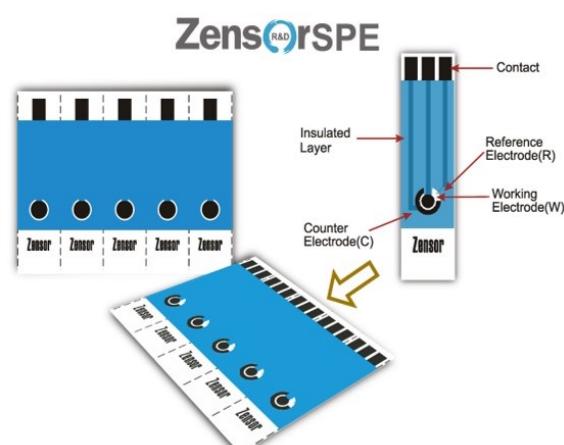


Fig. 9. DPV of the p-ATet modified GC electrode scanned under various concentrations of dopamine: 5  $\mu\text{M}$ , 10  $\mu\text{M}$ , 50  $\mu\text{M}$ , 100  $\mu\text{M}$ , 300  $\mu\text{M}$ , 600  $\mu\text{M}$ , and 1.0 mM. The dependence of the resulted current against the concentration of dopamine is shown in the inset plot.





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## Highly active nanostructured water oxidation catalyst electrodeposited from Co(cyclam) complex

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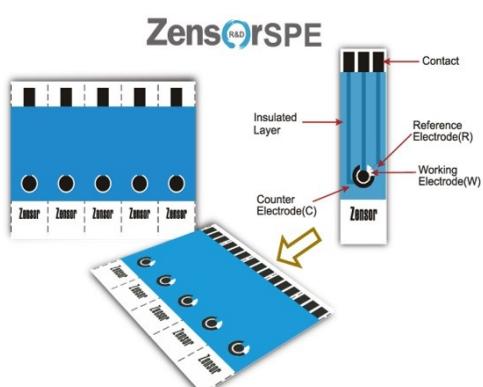
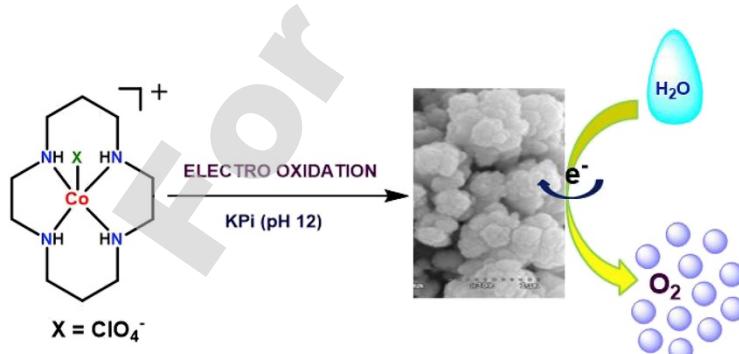
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### ABSTRACT

The water soluble molecular complex  $[\text{Co}(\text{cyclam})(\text{ClO}_4)]\text{ClO}_4$  (cyclam = 1,4,8,11-tetraazacyclotetradecane) is utilized as a precursor for deposition of highly active cobalt based nanostructured material on the electrode surface upon electrooxidation. The electrolysis of the complex at +1.1 V vs Ag/AgCl in 0.1 M potassium phosphate at pH 12 leads to the formation of a nanoporous Co(II) hydroxide/phosphate thin film on the printed carbon electrode. The deposited surface was characterized by scanning electron microscopy (SEM), energy-dispersive X-ray analysis (EDX), and X-ray photoelectron spectroscopy (XPS). The modified electrode (Co-PCE-12) is stable for more than 34 h during the continuous electrolysis. The modified electrode exhibits a high water oxidation catalytic activity of  $6.5 \text{ mA cm}^{-2}$  at an overpotential of 580 mV (0.9 V vs Ag/AgCl (3 M KCl) at pH 12) with 98% Faradaic yield.

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## Electrochemistry Communications

journal homepage: [www.elsevier.com/locate/elecom](http://www.elsevier.com/locate/elecom)



# Polyacrylamide-lithium chloride polymer electrolyte and its applications in electrochemical capacitors

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## ARTICLE INFO

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### Keywords:

Solid supercapacitors

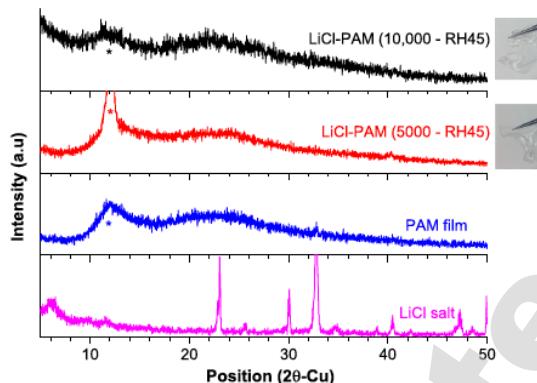
Neutral pH electrolyte

Polymer electrolyte

## ABSTRACT

A neutral polymer electrolyte containing lithium chloride (LiCl) and polyacrylamide (PAM) was developed. The LiCl-PAM electrolyte film had an amorphous structure and an ionic conductivity  $> 10 \text{ mS cm}^{-1}$ . The addition of LiCl to the polyacrylamide did not alter the chemical bonding of PAM. Symmetric double layer capacitors (EDLC) were constructed using CNT-graphite electrodes. The solid EDLC retained approximately 85% of the capacitance achieved with a baseline cell in a LiCl aqueous solution. The solid EDLC devices demonstrated a wide voltage window (1.5 V), good cycle life ( $> 10,000$  cycles), and excellent rate capability (up to  $5 \text{ V s}^{-1}$ ).

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\*: silicon vacuum grease

Fig. 2. XRD patterns of LiCl-PAM film vs. its components indicating the amorphous nature of the LiCl-PAM electrolyte. Inset: film appearance for both concentrations.

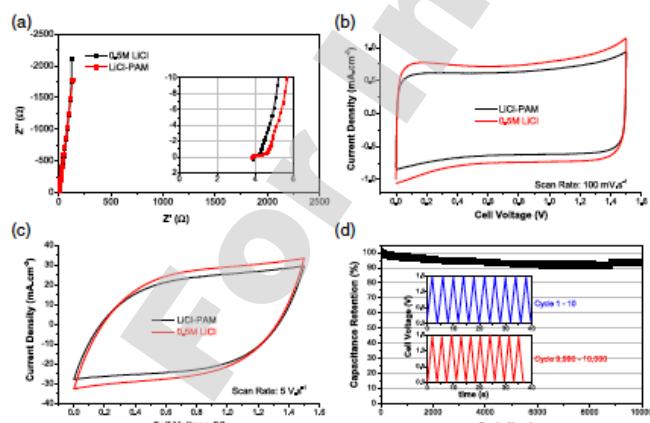


Fig. 4. Solid cell performance of CNT graphite with LiCl-PAM(10000) electrolyte (—) vs. 0.5 M LiCl liquid electrolyte (—): (a) EIS spectra, inset at high frequency; (b) CV at  $5 \text{ V s}^{-1}$ , (c) CV at  $5 \text{ V s}^{-1}$ ; and (d) capacitance retention up to 10,000 cycles with galvanostatic charge/discharge at  $5 \text{ A g}^{-1}$  current load, insets cycling profiles for first and last 10 cycles.

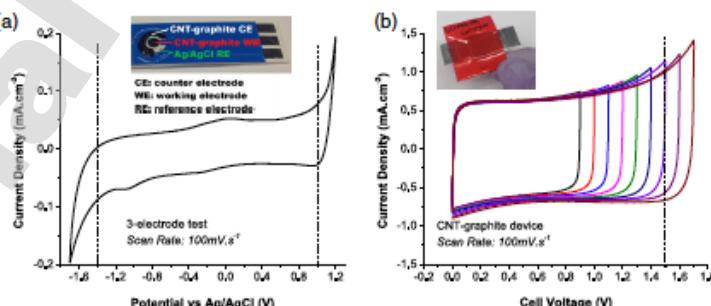
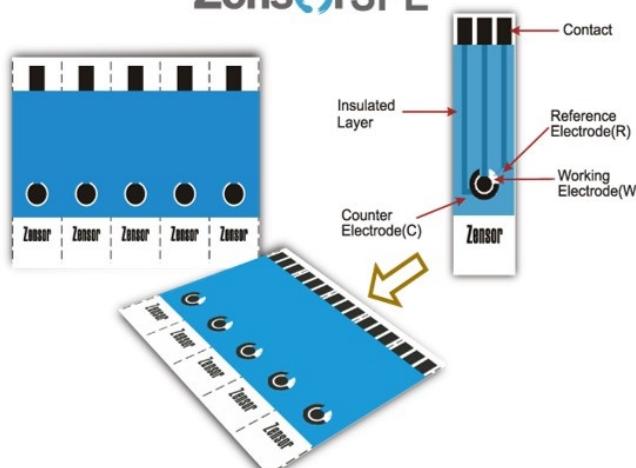


Fig. 3. LiCl-PAM(10000) electrochemical stability window with CNT-graphite electrode in (a) 3-electrode screen-printed and (b) incremental CV of symmetric cell; inset showing actual device.

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# Highly active nanostructured water oxidation catalyst electrodeposited from Co(cyclam) complex



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## ABSTRACT

The water soluble molecular complex  $[\text{Co}(\text{cyclam})(\text{ClO}_4)]\text{ClO}_4$  (cyclam = 1,4,8,11-tetraazacyclotetradecane) is utilized as a precursor for deposition of highly active cobalt based nanostructured material on the electrode surface upon electrooxidation. The electrolysis of the complex at +1.1 V vs Ag/AgCl in 0.1 M potassium phosphate at pH 12 leads to the formation of a nanoporous Co(II) hydroxide/phosphate thin film on the printed carbon electrode. The deposited surface was characterized by scanning electron microscopy (SEM), energy-dispersive X-ray analysis (EDX), and X-ray photoelectron spectroscopy (XPS). The modified electrode (Co-PCE-12) is stable for more than 34 h during the continuous electrolysis. The modified electrode exhibits a high water oxidation catalytic activity of  $6.5 \text{ mA cm}^{-2}$  at an overpotential of 580 mV (0.9 V vs Ag/AgCl (3 M KCl) at pH 12) with 98% Faradaic yield.

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### Keywords:

Oxygen evolution reaction

Electrocatalysts

Cobalt complex

Modified electrode

Water splitting

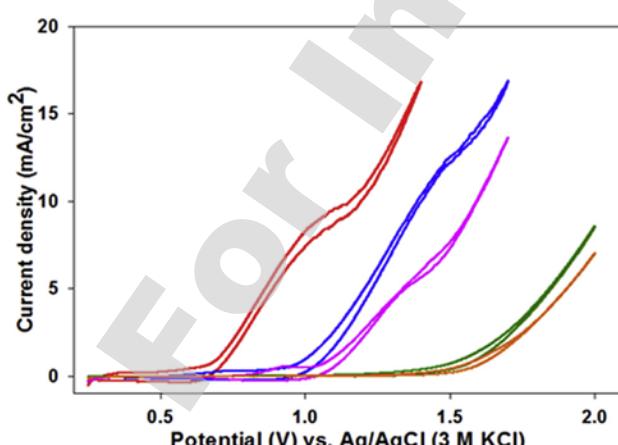
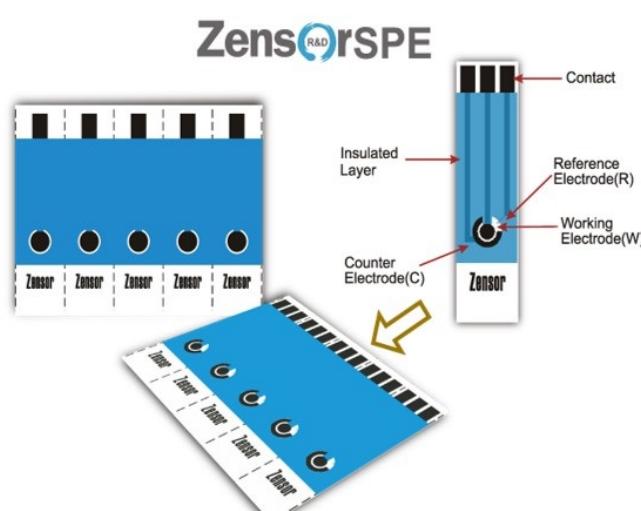


Fig. 5 – Cyclic voltammograms of Co-PCE-12 in 0.1 M KPi solutions with different pH values (12, 9, 7, 5.5, and 2, from left to right) under an Ar atmosphere.  $v = 5 \text{ mV/s}$ .





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## Electrochemistry Communications

journal homepage: [www.elsevier.com/locate/elecom](http://www.elsevier.com/locate/elecom)

# Li<sub>2</sub>SO<sub>4</sub>-polyacrylamide polymer electrolytes for 2.0 V solid symmetric supercapacitors

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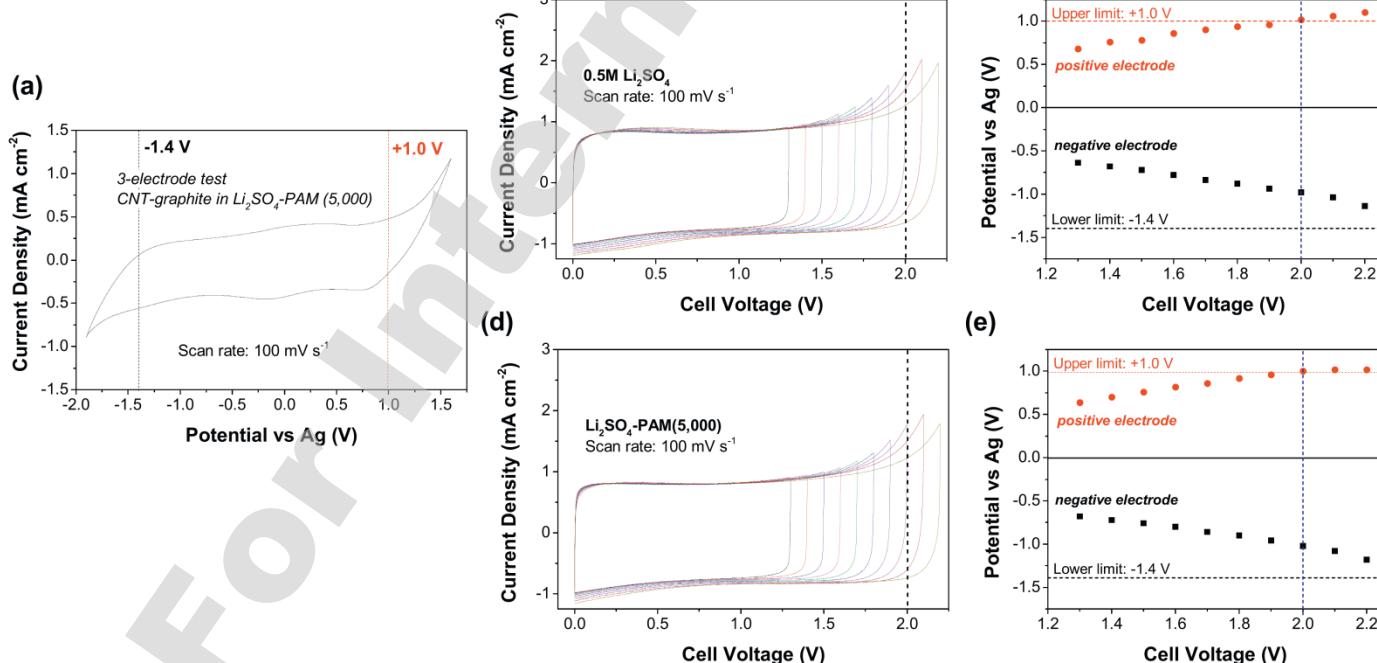


### ARTICLE INFO

### ABSTRACT

**Keywords:**  
Solid supercapacitor  
Polymer electrolyte  
Neutral pH electrolyte  
Wide voltage window

A neutral polymer electrolyte comprised of lithium sulfate (Li<sub>2</sub>SO<sub>4</sub>) and polyacrylamide (PAM) was developed. The Li<sub>2</sub>SO<sub>4</sub>-PAM electrolyte film shows an ionic conductivity up to 10 mS cm<sup>-1</sup> in 45%RH conditions. Solid double layer capacitors were demonstrated using CNT-graphite electrodes and Li<sub>2</sub>SO<sub>4</sub>-PAM solid electrolytes. The voltage window of the solid cell was about 2.0 V, identical to that of a Li<sub>2</sub>SO<sub>4</sub> liquid cell used as baseline. The demonstrated voltage window is significantly larger than that reported for proton- or hydroxyl-conducting electrolytes, suggesting that the Li<sub>2</sub>SO<sub>4</sub>-PAM electrolyte is a promising system for high energy density supercapacitors. The solid device also demonstrated excellent rate capability (up to 5 V s<sup>-1</sup>) and good cycle life (beyond 10,000 charge/discharge cycles).



**Fig. 1.** Voltage window determined by (a) the full-range stability window with 3-electrode test of CNT-graphite electrodes in Li<sub>2</sub>SO<sub>4</sub> electrolytes, along with cyclic voltammetry and simultaneous electrode polarizations of CNT-graphite cells with (b–c) 0.5 M Li<sub>2</sub>SO<sub>4</sub> liquid electrolytes and (d–e) Li<sub>2</sub>SO<sub>4</sub>-PAM(5000) solid electrolytes.



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## Thin Solid Films

journal homepage: [www.elsevier.com/locate/tsf](http://www.elsevier.com/locate/tsf)



# Surface modified catalytically grown carbon nanofibers/MnO<sub>2</sub> composites for use in supercapacitor

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Carbon nanofiber

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Supercapacitor

Acid treatment

Microwave-assisted hydrothermal

## ABSTRACT

We have reported a fast and eco-friend method to synthesize the MnO<sub>2</sub> on catalytically grown carbon nanofiber (CGCNF). The CGCNF was functionalized by acid treatment under various H<sub>2</sub>SO<sub>4</sub>/HNO<sub>3</sub> ratios. A microwave-assisted hydrothermal method was then used to synthesize MnO<sub>2</sub>/CGCNF composites at a very short time of 5 min. We demonstrated that the surface modification has significant effect on the MnO<sub>2</sub> deposition and the electrochemical performance of the resulting MnO<sub>2</sub>/CGCNF composites. Electrical impedance spectroscopy analysis and cyclic voltammetry showed that O-functional group controls the electrical conductivity and the electrochemical performance of both CGCNF and CGCNF/MnO<sub>2</sub> composites, respectively. It was found that C=O bond assists the MnO<sub>2</sub> deposition. CGCNF/MnO<sub>2</sub> composite showing specific capacitance (C<sub>sp</sub>) of 257 F/g at a scan rate of 5 mV/s and electrical resistance of 19 Ω was demonstrated.

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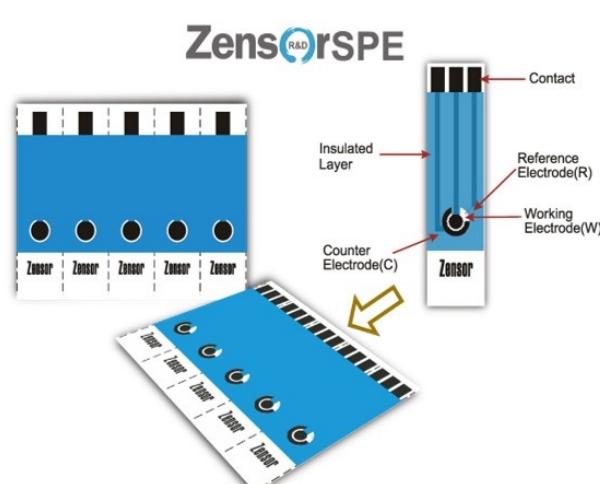
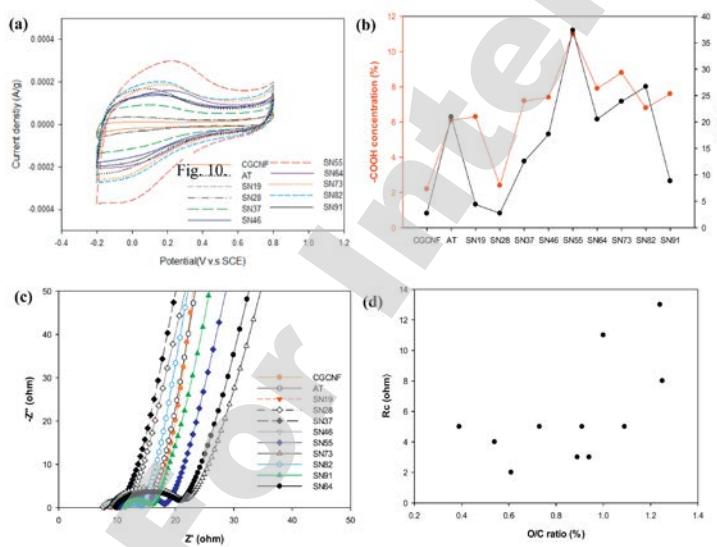


Fig. 9. (a) CV curves of CGCNF. (b) Variations of -COOH concentration and C<sub>sp</sub> from sample to sample. (c) Nyquist plots of CGCNF. (d) R<sub>c</sub> increases with the O/C ratio.

## Electroactive Biofilm Serving as the Green Synthesizer and Stabilizer for *in Situ* Fabricating 3D Nanopalladium Network: An Efficient Electrocatalyst

Ya-Nan Hou,<sup>†</sup> Huan Liu,<sup>§</sup> Jing-Long Han,<sup>‡</sup> Wei-Wei Cai,<sup>†</sup> Jizhong Zhou,<sup>†,||</sup> Ai-Jie Wang,<sup>\*,†,‡</sup> and Hao-Yi Cheng<sup>\*,‡</sup>

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<sup>‡</sup>Key Laboratory of Environmental Biotechnology, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing 100085, P.R. China

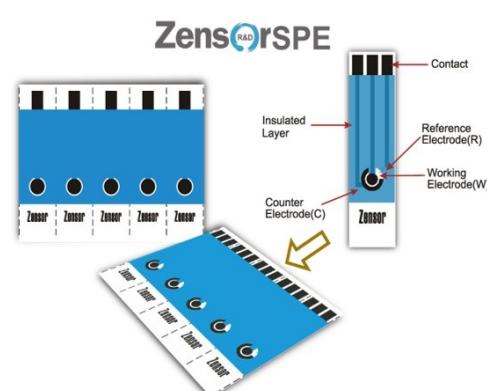
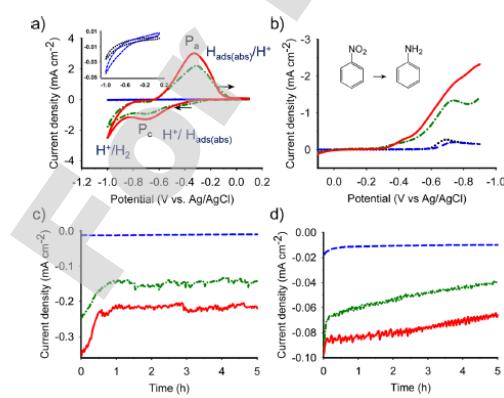
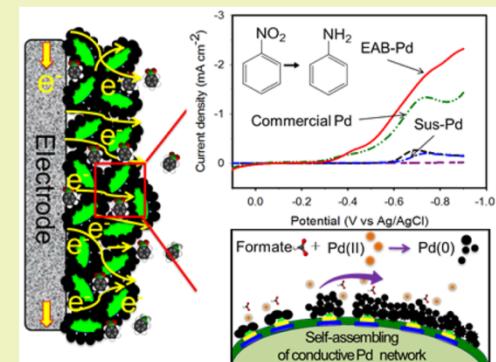
<sup>\*</sup>Key Laboratory of Bio-Inspired Smart Interfacial Science and Technology of Ministry of Education, Beijing Key Laboratory of Bio-inspired Energy Materials and Devices, School of Chemistry and Environment, Beihang University, Beijing 100191, P.R. China

<sup>||</sup>Institute for Environmental Genomics, and Department of Microbiology and Plant Biology, University of Oklahoma, Norman, Oklahoma 73019, United States

### Supporting Information

**ABSTRACT:** Biogenetic nanopalladium (bio-Pd) has attracted increasing attention recently due to its economical and environmental friendly synthesis route. However, traditional bacteria suspensions formed palladium (Sus-Pd) is limited to be the electrochemical catalyst owing to the poor conductivity of bacterial cells. Herein, we demonstrated Pd nanoparticles, synthesized by electroactive *Geobacter* biofilm, can form a three-dimensional conductive network (EAB-Pd) that is beneficial to the electrons transfer. As a result, the EAB-Pd delivered an over 5-fold increase of current compared to the Sus-Pd in hydrogen evolution and the reductive degradation of nitro-, azo- and chloroaromatics. Superior performance of EAB-Pd was also observed in comparison with the commercial Pd catalyst. A good stability of EAB-Pd has been further confirmed under electrochemical and mechanical stresses as well as through the reuse after over 3 months of storage. This novel proposed method enables the direct electrochemical application of bio-Pd without the previous required cell carbonization and chemical binders.

**KEYWORDS:** Nanopalladium, Electroactive biofilm, Conductive 3D network, *In situ* fabrication, Reductive catalysis



# Journal of Materials Chemistry A

## PAPER

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Cite this: *J. Mater. Chem. A*, 2016, **4**, 9585

## A H<sub>5</sub>BW<sub>12</sub>O<sub>40</sub>–polyvinyl alcohol polymer electrolyte and its application in solid supercapacitors

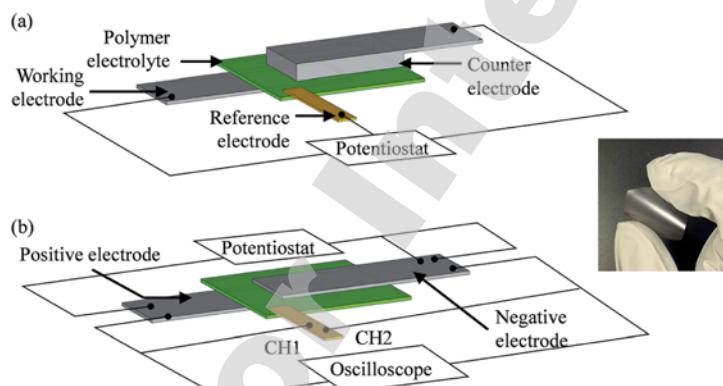
Han Gao<sup>†</sup> and Keryn Lian<sup>\*</sup>

A polymer electrolyte comprised of H<sub>5</sub>BW<sub>12</sub>O<sub>40</sub> (BWA) and cross-linked polyvinyl alcohol (BWA–XLPVA) has been developed and characterized for solid supercapacitors. The performance of this polymer electrolyte was compared to that of a known polymer electrolyte based on H<sub>4</sub>SiW<sub>12</sub>O<sub>40</sub> (SiWA). An enhanced proton conductivity was observed for BWA–XLPVA compared to its SiWA counterpart, especially under low humidity conditions (5% RH). Dielectric analyses revealed an increase of proton density and proton mobility in the BWA-based electrolyte. A solid-state <sup>1</sup>H NMR study showed that all protons in the BWA-based electrolyte were hydrated in the low humidity environment. This indicated that BWA had more crystallized water content than SiWA, resulting in higher proton mobility in the PVA matrix. An *in situ* tracking of electrode potential in solid supercapacitors was utilized to identify the reactions and the factors limiting solid supercapacitor cell voltage for both BWA- and SiWA-based polymer electrolyte systems. A solid device leveraging the BWA-based polymer electrolyte achieved a cell voltage of 1.3 V, 0.2 V wider than that of a SiWA-based device.

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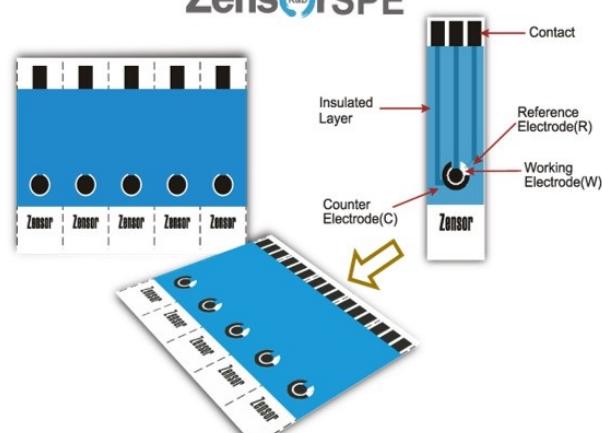
DOI: 10.1039/c6ta03196j

[www.rsc.org/MaterialsA](http://www.rsc.org/MaterialsA)



**Fig. 1** Schematic diagrams of (a) a 3-electrode system for single electrode characterization and (b) a 2-electrode system for supercapacitor device characterization with *in situ* potential tracking (the inset shows a photograph of a polymer electrolyte film).

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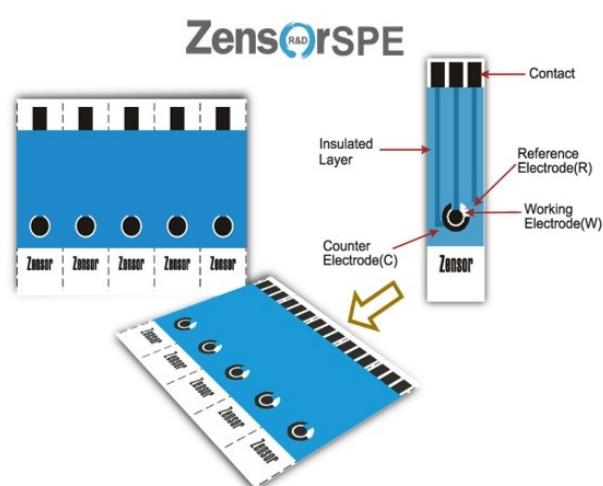
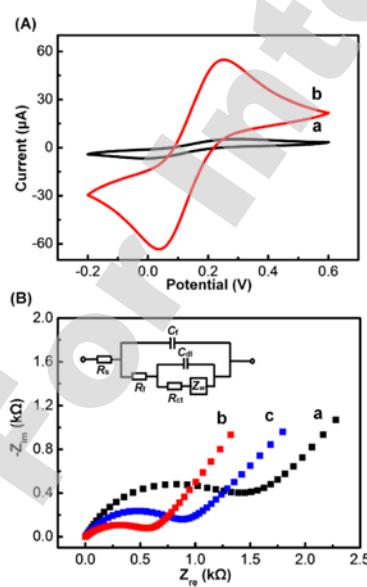
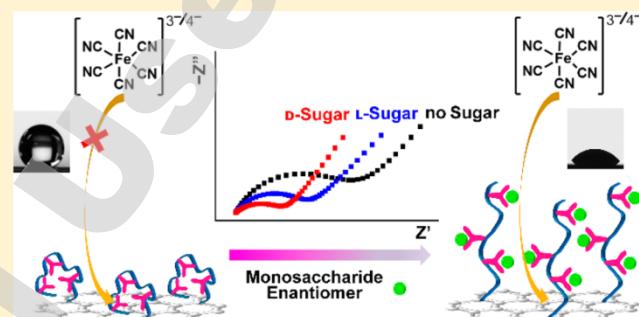
## Wettability Switching of Electrode for Signal Amplification: Conversion of Conformational Change of Stimuli-Responsive Polymer into Enhanced Electrochemical Chiral Analysis

Shushu Ding, Sumei Cao, Anwei Zhu,\* and Guoyue Shi\*

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### Supporting Information

**ABSTRACT:** Signal amplification of chiral interaction is a much needed task for sensing of enantiomers due to nearly identical chemical and physical properties of the chiral isomers. In this article, we established an electrochemical chiral sensing method with high sensitivity and selectivity for monosaccharides based on the stimuli-responsive copolymer/graphene hybrid-modified screen-printed carbon electrodes. The hybrid synthesized by the “grafting from” atom transfer radical polymerization (ATRP) process not only acted as a chiral recognition element but also provided a chiral signal amplification strategy. This occurs due to high sensitivity of conformational transition of copolymer on graphene to the weak chiral interactions that greatly facilitating the diffusion of electroactive probes and monosaccharides to the electrode surface. The described method can quantify monosaccharides, even the concentration of one enantiomer is as low as 1 nM. Apart from the demonstrated chiral distinguish ability, good selectivity toward monosaccharides in comparison to potential interference molecules was also observed. The electrodes with significant analytical performance were successfully applied for discriminating glucose enantiomers in live cells and studying their different transport mechanism. Together, the results show that the coupling of amplification-by-wettability switching concept with electrochemical method offers great promises in providing a sensitive, facile, and cost-effective solution for chiral recognition of molecules in biological process.





Cite this: *Anal. Methods*, 2016, 8, 5495

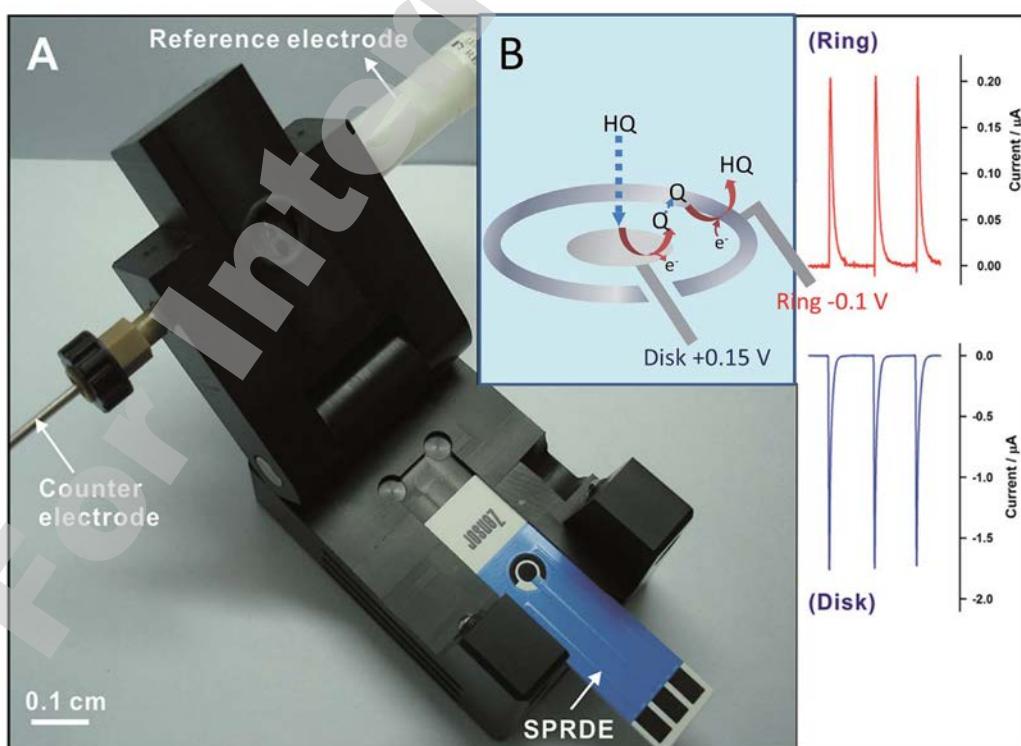
## Self-validated detection of hydroquinone in medicated cosmetic products using a preanodized screen-printed ring disk carbon electrode

Hsueh-Hui Yang,<sup>\*a</sup> Hsiao-Han Ting<sup>b</sup> and Ying Shih<sup>\*b</sup>

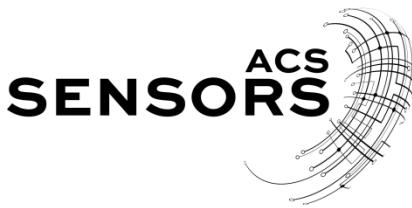
An anodically pretreated screen-printed ring disk carbon electrode (SPRDCE\*) coupled with a flow injection analysis system was developed as a simple, rapid, sensitive, and self-validated hydroquinone (HQ) sensor. HQ was electrocatalytically oxidized at the preanodized disk electrode and the oxidized product para-benzoquinone was then electrocatalytically reduced to HQ at the preanodized ring electrode. A well-defined and quasireversible redox peak couple was observed. The amount of HQ could be determined by using the catalytic current from the SPRDCE\*. Besides, it is also worth noting that the performance of this system could be validated directly by using the redox current ratio (the reduction current at the ring electrode divided by the oxidation current at the disk electrode). Under optimized conditions, a linear range for HQ at the disk electrode was in the range of 0.25–160 ppm with 0.999 and 0.024 ppm for the correlation coefficient and the detection limit ( $S/N = 3$ ), respectively. Using this method, HQ in cosmetic products was successfully quantified without any pre-treatment with recoveries between 97.76% and 103.74%.

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DOI: 10.1039/c6ay01000h  
[www.rsc.org/methods](http://www.rsc.org/methods)



Scheme 1 Schematic representation for monitoring of HQ at using the SPRDCE\* coupled with FIA.



## Digital pH Test Strips for In-Field pH Monitoring Using Iridium Oxide-Reduced Graphene Oxide Hybrid Thin Films

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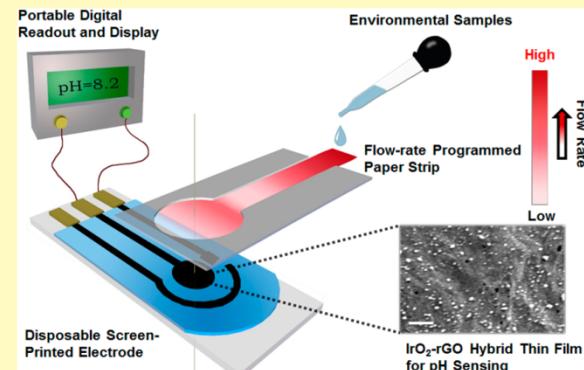
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### Supporting Information

**ABSTRACT:** While pH test strips are not decimal accurate and only semiquantitative, the more accurate and automated laboratory-based pH meters lack disposability and portability. Benefiting from advantages of both sides and filling the gap of unmet needs in between, we integrated a miniaturized paper-fluidic electrochemical pH platform coupled with a portable pH device powered by consumer batteries to make digital pH test strips for truly in-field measurements. To overcome the inability to form the smooth and uniform pH-sensitive functionality on screen-printed carbon, i.e., anodically electrodeposited iridium oxide thin films (AEIROFs), reduced graphene oxide was used as substrate for synthesis of homogeneous metal oxide–nanocarbon hybrid thin films, IrO<sub>2</sub>-reduced graphene oxide (IrO<sub>2</sub>-rGO), as the sensing moiety with strong substrate adhesion. A hydrophobic barrier-patterned paper micropad ( $\mu$ PAD) with programmed flow rates can locally accelerate linear wicking speed to boost delivery and response time. IrO<sub>2</sub>-rGO shows slightly super-Nernstian linear responses from pH 2 to 12 with small hysteresis, fast response time, reproducible performances, and low sensitivities to interfering ionic species and dissolved oxygen. A miniaturized portable pH device made of high-impedance buffer amplifier and off-the-shelf digital multimeter provides results consistent with those of a commercial pH meter equipped with a glass electrode. Our system combines the accuracy of pH meters with the low-cost and convenience of pH strips, making it ideal for resource-limited settings.

**KEYWORDS:** iridium oxide, graphene, paper-fluidic, potentiometric sensor, pH sensor, electrochemistry, programmed flow rate, hydrophobic patterning





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# Electrochemically monitoring the antibiotic susceptibility of *Pseudomonas aeruginosa* biofilms†

Thaddaeus A. Webster, Hunter J. Sismaet, I-ping J. Chan and Edgar D. Goluch\*

The condition of cells in *Pseudomonas aeruginosa* biofilms was monitored via the electrochemical detection of the electro-active virulence factor pyocyanin in a fabricated microfluidic growth chamber coupled with a disposable three electrode cell. Cells were exposed to 4, 16, and 100 mg L<sup>-1</sup> colistin sulfate after overnight growth. At the end of testing, the measured maximum peak current (and therefore pyocyanin concentration) was reduced by approximately 68% and 82% in *P. aeruginosa* exposed to 16 and 100 mg L<sup>-1</sup> colistin sulfate, respectively. Samples were removed from the microfluidic chamber, analyzed for viability using staining, and streaked onto culture plates to confirm that the *P. aeruginosa* cells were affected by the antibiotics. The correlation between electrical signal drop and the viability of *P. aeruginosa* cells after antibiotic exposure highlights the usefulness of this approach for future low cost antibiotic screening applications.

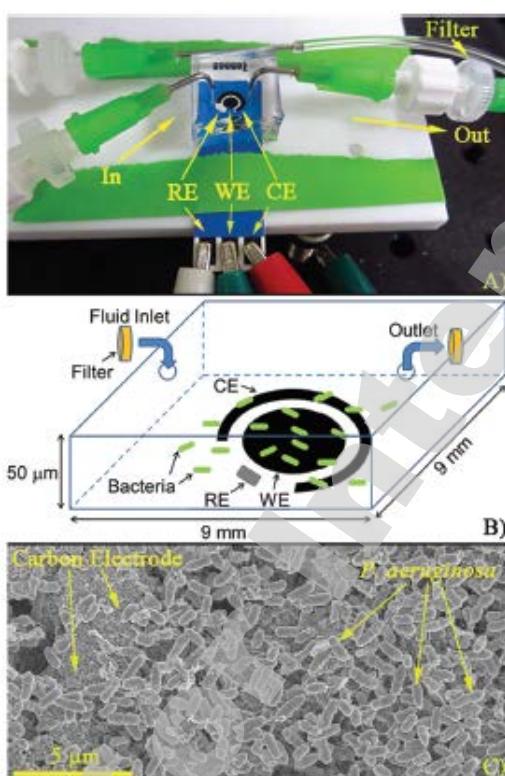


Fig. 1 Experimental apparatus. (A) Finished device connected to a potentiostat. Inlets and outlets contain filters (pore size 0.2 μm) to prevent PA14 from leaving the channels. (B) Schematic of the sensor covered with a microfluidic chamber (not to scale). Bacteria are trapped in the chamber while fluid moves in and out. (C) Scanning electron micrograph (SEM) of PA14 grown on top of the carbon working electrode after overnight growth under stagnant conditions. Reference, Working, and Counter Electrodes (RE, WE, and CE, respectively).

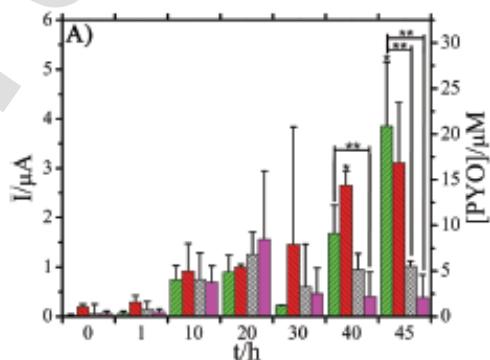
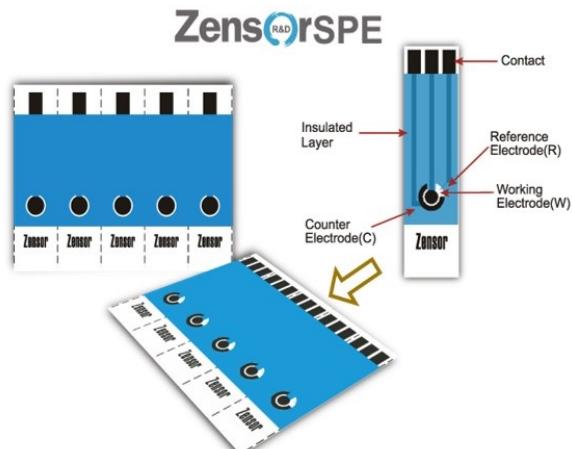


Fig. 3 (A) Response of PA14 biofilms at selected time points during the 48 hour experiments. (BL = blank loaded into the chamber). Left axis: average peak current (blank subtracted) measured over time in PA14 cultures exposed to colistin sulfate at 0 (green right slash), 4 (red left slash, low MIC), 16 (blue cross, High MIC), and 100 mg L<sup>-1</sup> (pink no slash lines). Right axis: approximate pyocyanin concentration based on calibration curve. \* indicates time points where only two replicates were used. \*\* indicates  $P < 0.05$  from ANOVA analysis of the 16 and 100 mg L<sup>-1</sup> antibiotic concentrations against the control.



# SCIENTIFIC REPORTS



## Fluorographene based Ultrasensitive Ammonia Sensor

Kiran Kumar Tadi, Shubhadeep Pal & Tharangattu N. Narayanan

Single molecule detection using graphene can be brought by tuning the interactions *via* specific dopants. Electrostatic interaction between the most electronegative element fluorine (F) and hydrogen (H) is one of the strong interactions in hydrogen bonding, and here we report the selective binding of ammonia/ammonium with F in fluorographene (FG) resulting to a change in the impedance of the system. Very low limit of detection value of ~0.44 pM with linearity over wide range of concentrations (1 pM–0.1 μM) is achieved using the FG based impedance sensor, and this screen printed FG sensor works in both ionized (ammonium) and un-ionized ammonia sensing platforms. The interaction energies of FG and NH<sub>3</sub>/NH<sub>4</sub><sup>+</sup> are evaluated using density functional theory calculations and the interactions are mapped. Here FGs with two different amounts of fluorine contents —~5 atomic% (C<sub>39</sub>H<sub>16</sub>F<sub>2</sub>) and ~24 atomic% (C<sub>39</sub>H<sub>16</sub>F<sub>12</sub>) - are theoretically and experimentally studied for selective, high sensitive and ultra-low level detection of ammonia. Fast responding, high sensitive, large area patternable FG based sensor platform demonstrated here can open new avenues for the development of point-of-care devices and clinical sensors.

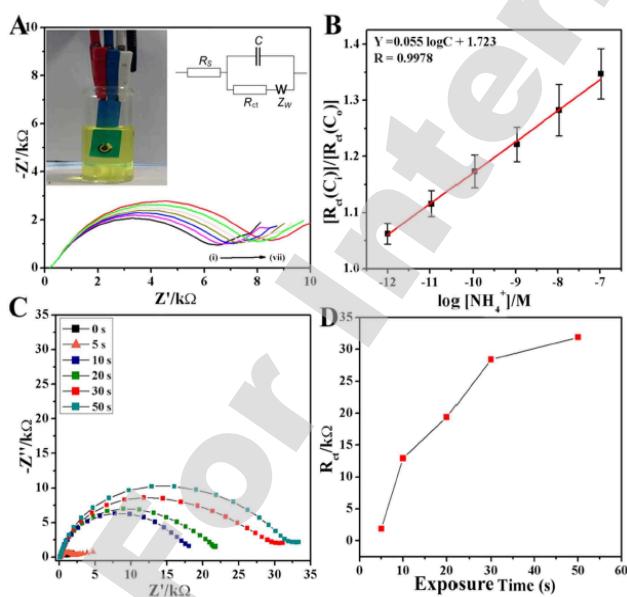
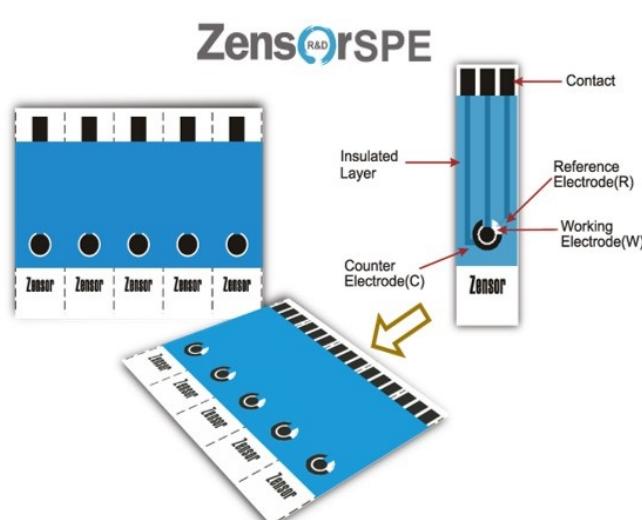


Figure 4. (A) Nyquist plots of FG coated electrode on SPE sensor for varying ammonium ion (NH<sub>4</sub><sup>+</sup>) concentrations (i. blank, ii. 1 pM, iii. 10 pM, iv. 100 pM, v. 1 nM, vi. 10 nM, and vii. 0.1 μM), (inset) the photograph of an FG coated SPE sensor, (B) normalized charge transfer resistance for various ammonium ion concentrations, (C) Nyquist plots showing increased impedance with increase in direct NH<sub>3</sub> exposing time, (D) R<sub>ct</sub> values with varying direct NH<sub>3</sub> exposures.



ARTICLE

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OPEN

# Adhesive curing through low-voltage activation

Jianfeng Ping<sup>1,2,\*</sup>, Feng Gao<sup>1,\*</sup>, Jian Lin Chen<sup>1</sup>, Richard D. Webster<sup>3</sup> & Terry W.J. Steele<sup>1</sup>

Instant curing adhesives typically fall within three categories, being activated by either light (photocuring), heat (thermocuring) or chemical means. These curing strategies limit applications to specific substrates and can only be activated under certain conditions. Here we present the development of an instant curing adhesive through low-voltage activation. The electrocuring adhesive is synthesized by grafting carbene precursors on polyamidoamine dendrimers and dissolving in aqueous solvents to form viscous gels. The electrocuring adhesives are activated at  $-2\text{ V}$  versus  $\text{Ag}/\text{AgCl}$ , allowing tunable crosslinking within the dendrimer matrix and on both electrode surfaces. As the applied voltage discontinued, crosslinking immediately terminated. Thus, crosslinking initiation and propagation are observed to be voltage and time dependent, enabling tuning of both material properties and adhesive strength. The electrocuring adhesive has immediate implications in manufacturing and development of implantable bioadhesives.

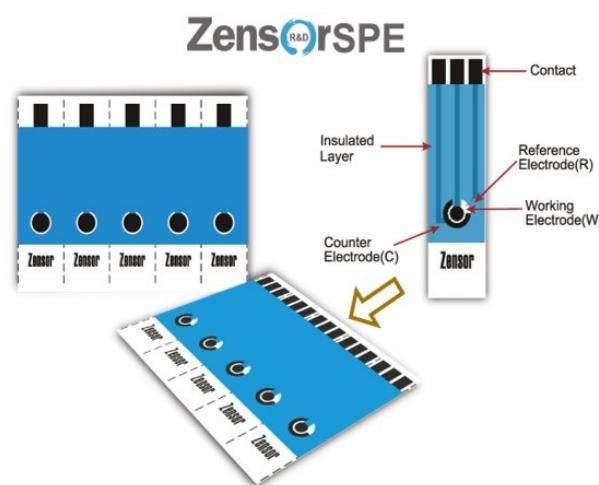
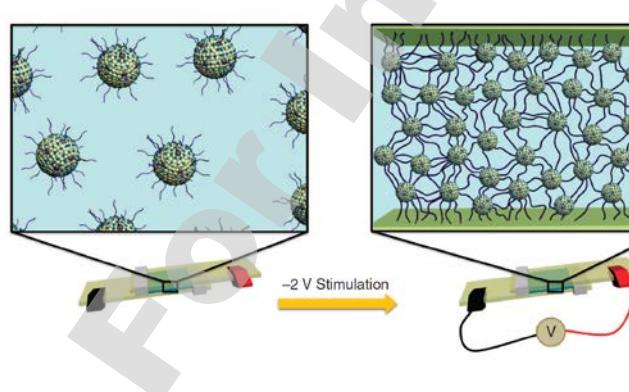


Figure 1 | Concept of electrocuring adhesive. Low-voltage activation allows polymer and substrate crosslinking.



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## Bismuth oxide nanoparticles as a nanoscale guide to form a silver–polydopamine hybrid electrocatalyst with enhanced activity and stability for the oxygen reduction reaction†

Settu Murali, Jen-Lin Chang and Jyh-Myng Zen\*

Highly dispersed Ag nanoparticles (Ag NPs) were successfully synthesized on functionalized polydopamine (PDA) $\text{@Bi}_2\text{O}_3$  NPs for use as an electrocatalyst. In the proposed method, a uniform layer of PDA was first coated on  $\text{Bi}_2\text{O}_3$  NPs. The surface of the PDA $\text{@Bi}_2\text{O}_3$  can then be used as a nanoscale guide to deposit Ag NPs and hence for the formation of Ag–PDA $\text{@Bi}_2\text{O}_3$  hybrid nanocatalysts. It was found that Ag NPs enhanced the electrocatalytic ability on PDA $\text{@Bi}_2\text{O}_3$  by a synergistic effect for direct  $4\text{e}^-$  transfer in the oxygen reduction reaction (ORR) with a low overpotential. The surface morphology and lattice fringes of Ag NPs of crystalline nature of the obtained Ag–PDA $\text{@Bi}_2\text{O}_3$  hybrid nanocatalysts were examined through HR-TEM and SAED patterns. The material's purity and chemical functional groups were identified by FT-IR analysis. This strategy provides new opportunities to design and optimize heterogeneous nanocatalysts with tailored size, morphology, chemical configuration and supporting substrates for metal-catalyzed reactions.

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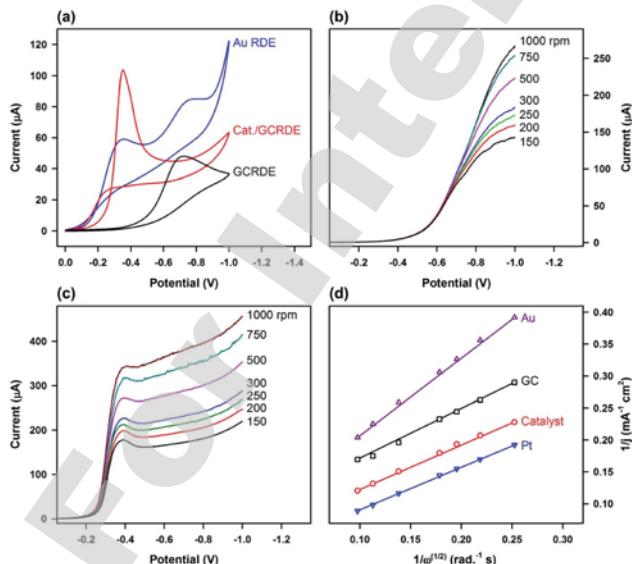
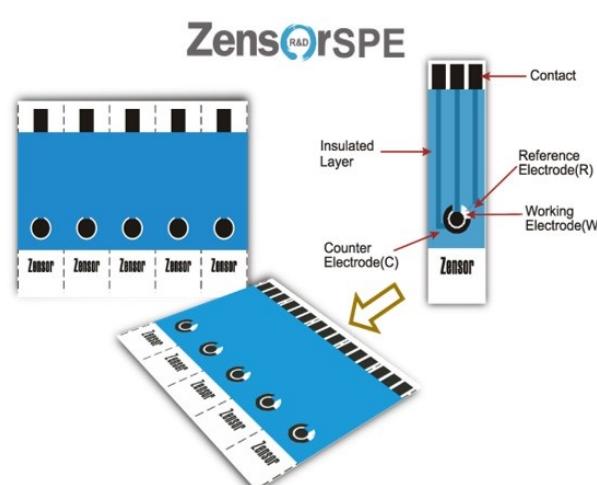


Fig. 5 (a) Cyclic voltammograms for ORR at different RDEs. RDE voltammetry curve for ORR on GCRDE (b) and Ag–PDA $\text{@Bi}_2\text{O}_3$ -modified GCRDE (c) in 0.1 M  $\text{O}_2$ -saturated PBS (pH 7.4) at various rotation rates. (c) RDE diffusion curve of different electrodes (GC at  $-0.9$  V, Ag–PDA $\text{@Bi}_2\text{O}_3$  at  $-0.38$  V). (d) K-L plots.



# Electrochemical Synthesis and Deposition of Surface-Enhanced Raman Scattering-Active Silver Microstructures on a Screen-Printed Carbon Electrode

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**S Supporting Information**

**ABSTRACT:** We demonstrated a series of Ag microstructures with controlled morphologies directly deposited on a screen-printed carbon electrode by using electrochemical procedures in the presence of different electrolytes. Scanning electron microscopy, transmission electron microscopy, energy-dispersive X-ray spectroscopy, and high-resolution X-ray diffractometry were used for characterizing as-prepared Ag substrates. Thereafter, the potential of the flower-like Ag microstructures for use in surface-enhanced Raman scattering (SERS) applications was investigated. The flower-like Ag microstructures provided a more intense SERS signal because of extremely intense local electromagnetic fields. The enhancement factor value was approximately  $1.2 \times 10^6$  for 4-mercaptopbenzoic acid molecules. The percentage of relative standard deviation of SERS signals was lower than 2.1%. Determining the SERS spectra of 4,4'-dimercaptoazobenzene, 5,5'-dithiobis-2-nitrobenzoic acid, adenine, and single-stranded DNA (fumarylacetoacetate hydrolase gene) was straightforward. Furthermore, the thermal stability and aging behavior of the microstructures were improved. The present substrate fabrication process is facile and has excellent SERS-active properties and reproducibility and thus provides opportunities for quantitative analysis by using flower-like Ag microstructures.

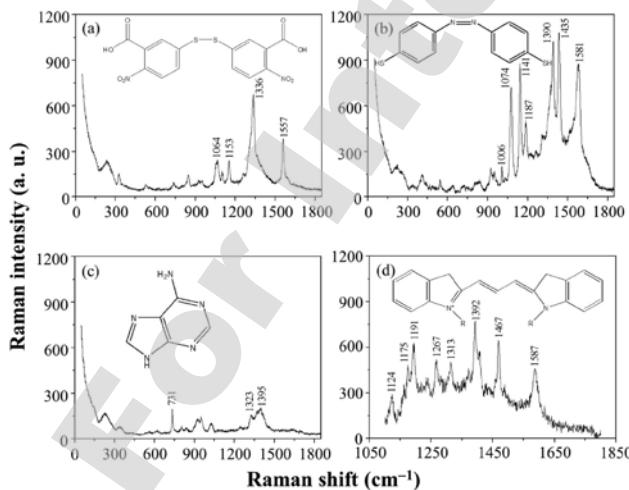
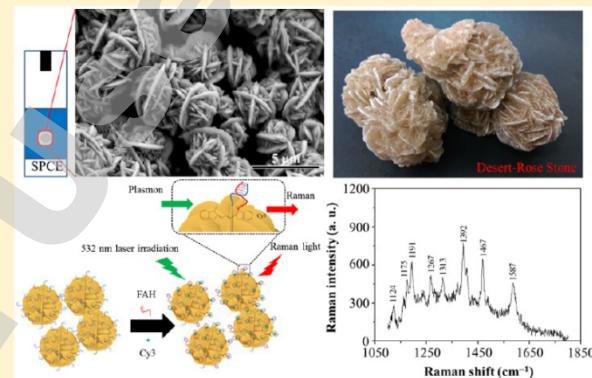
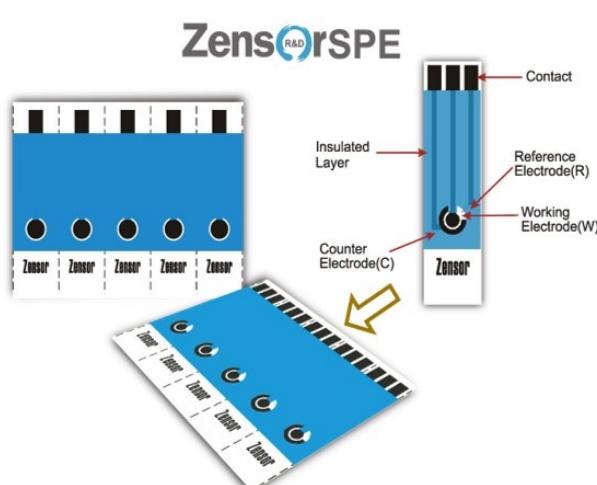


Figure 7. SERS spectra of (a) DTNB, (b) 4-ATP, (c) adenine, and (d) Cy3 from dsDNA adsorbed on substrate 2.





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## Impact electrochemistry: colloidal metal sulfide detection by cathodic particle coulometry†

Chee Shan Lim and Martin Pumera\*

The determination of the size and concentration of colloidal nano and microparticles is of paramount importance to modern nanoscience. Application of the particle collision technique on metal and metal oxide nanoparticles has been intensively explored over the past decade owing to its ability to determine the particle size and concentration via reactions including the inherent oxidation or the reduction of nanoparticles as well as surface reactions catalysed by the nanoparticles. Transition metal dichalcogenide particles were previously quantified using the anodic (oxidative) particle coulometry method. Here we show that cathodic (reductive) particle coulometry can be favorably used for the detection of metal sulfide colloidal particles. The detection of sulfides of cobalt and lead was performed using the particle collision technique in this work. The presence of spikes confirmed the viability of detecting new and larger particles from compounds using reductive (cathodic) potentials. Such an expansion of the impact particle coulometry method will be useful and applicable to the determination of concentration and size of colloidal metal sulfide nanoparticles in general.

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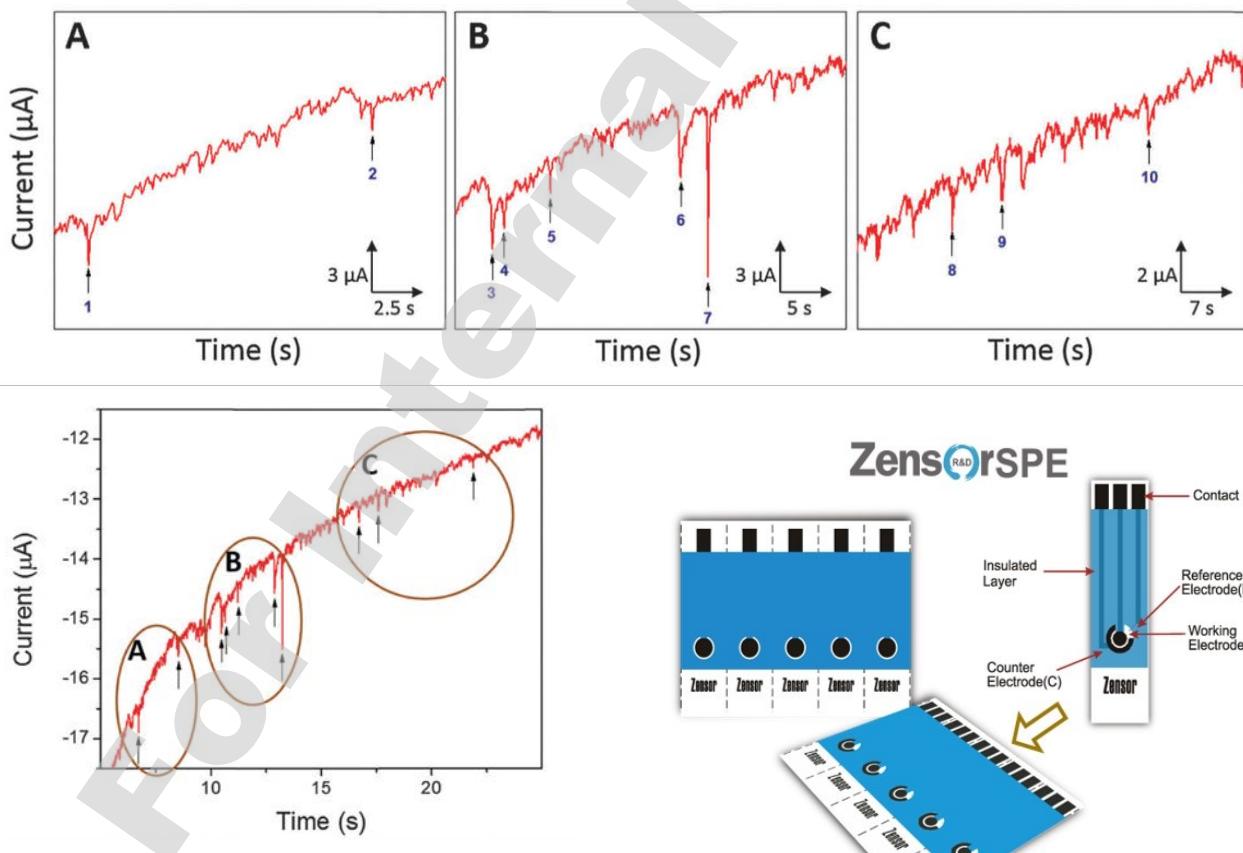


Fig. 3 Spikes selected for size determination study of CoS.



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## Electrochemistry Communications

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Short communication

### Susceptibility of FeS<sub>2</sub> hydrogen evolution performance to sulfide poisoning

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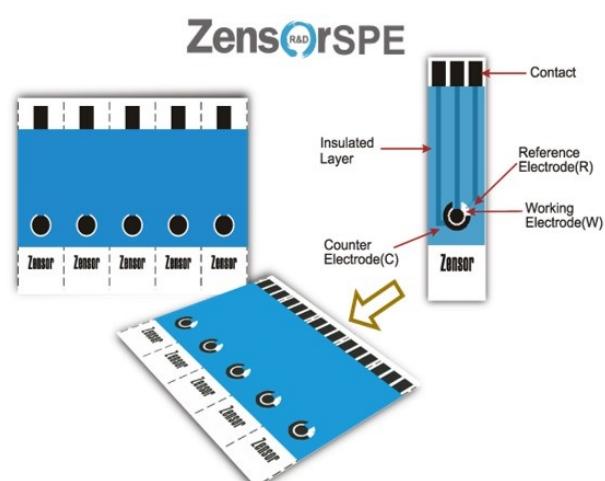
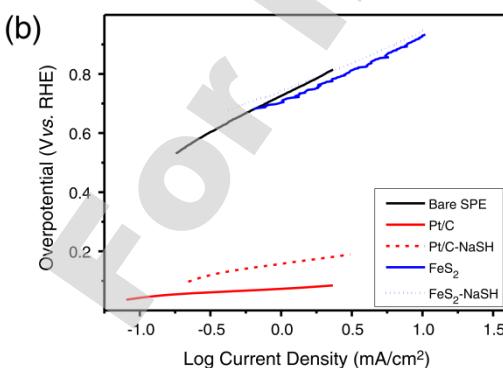
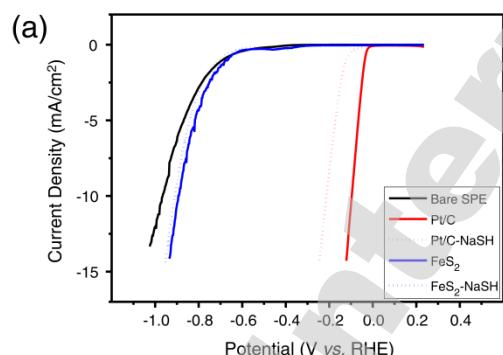
Sulfide

Poisoning

#### ABSTRACT

The imminent depletion of fossil fuels raises concern over the need for next-generation clean energy. Of numerous alternatives, electrochemical water splitting is a promising method to store energy in the form of hydrogen. In order to benefit from this system, technological advancement in the development of affordable and efficient electrocatalysts for hydrogen evolution reaction is necessary. Transition-metal electrocatalysts composing of earth-abundant elements, specifically natural FeS<sub>2</sub>, has demonstrated excellent performance for hydrogen evolution reaction. However, previous studies on platinum surfaces highlighted the detrimental effect toward hydrogen evolution performance upon poisoning of the active sites. In this work, we examine the susceptibility of natural FeS<sub>2</sub> toward sulfide poisoning. Our findings showed that the degradation effect from the introduction of sulfide to natural FeS<sub>2</sub> was not as severe as that observed on platinum. The overpotential (at a current density of 10 mA/cm<sup>2</sup>) for natural FeS<sub>2</sub> and platinum increased by approximately 20 and 110 mV, respectively.

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**Fig. 3.** Electrochemical characterization of bare screen printed electrode, Pt/C, poisoned Pt/C, FeS<sub>2</sub> and poisoned FeS<sub>2</sub> toward hydrogen evolution reactions. (a) Polarization curves of current density against potential. (b) Tafel analysis of overpotential against the log of current density.

## Magnetic control of electrochemical processes at electrode surface using iron-rich graphene materials with dual functionality

Chee Shan Lim,<sup>a</sup> Adriano Ambrosi,<sup>a</sup> Zdeněk Sofer<sup>b</sup> and Martin Pumera<sup>\*a</sup>

Metal-doped graphene hybrid materials demonstrate promising capabilities in catalysis and various sensing applications. There also exists great interest for on-demand control of the selectivity of many electrochemical processes. In this work, an iron-doped thermally reduced graphene oxide (Fe–TRGO) was prepared and used to investigate the possibility of a reproducible, magnetically controlled method to modulate electrochemical reactivities through a scalable method. We made use of the presence of both magnetic and electrocatalytic properties in the Fe–TRGOs to induce attraction and removal of the Fe–TRGO material onto and off the working electrode surfaces magnetically, thereby controlling the electrochemical oxidation and reduction processes. The outstanding electrochemical performance of the Fe–TRGO material was evident, with enhanced current signals and lower peak potentials observed upon magnetic activation. Reversible and reproducible cycles of activation and deactivation were obtained as the peak heights and peak potentials remained relatively consistent with no apparent carryover between every step. Both components of Fe–TRGO play an electrocatalytic role in the electrochemical sensing. In the cases of the oxygen reduction reaction and reduction of cumene hydroperoxide, the iron oxide plays the role of an electrocatalyst, while in the cases of ascorbic acid, the enhanced electroactivity originates from the high surface area of the graphene portion in the Fe–TRGO hybrid material. The feasibility of this magnetically switchable method for on-demand sensing and energy production thus brings about potential developments for future electrochemical applications.

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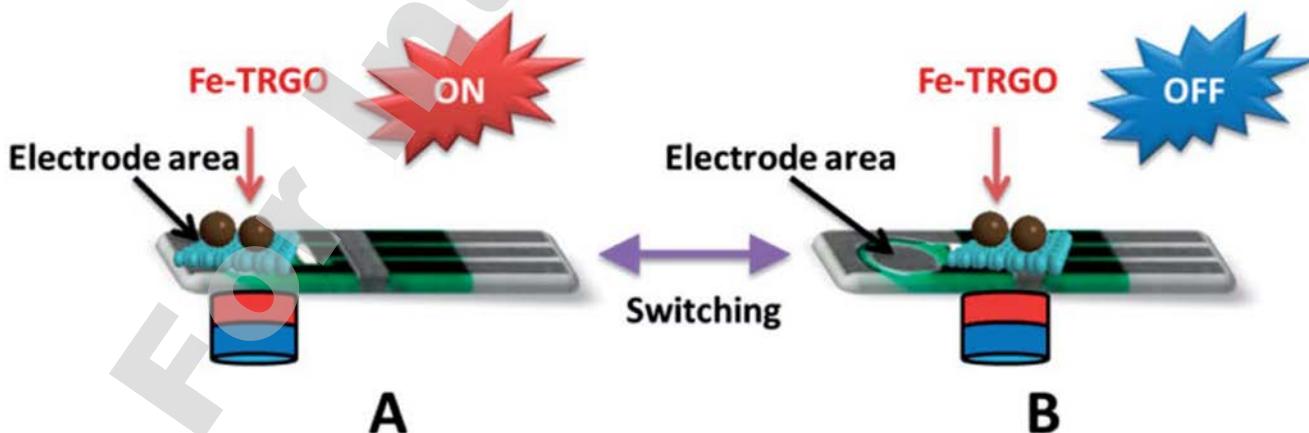


Fig. 3 Experimental setup for (A) activation and (B) deactivation of the electrochemical process.