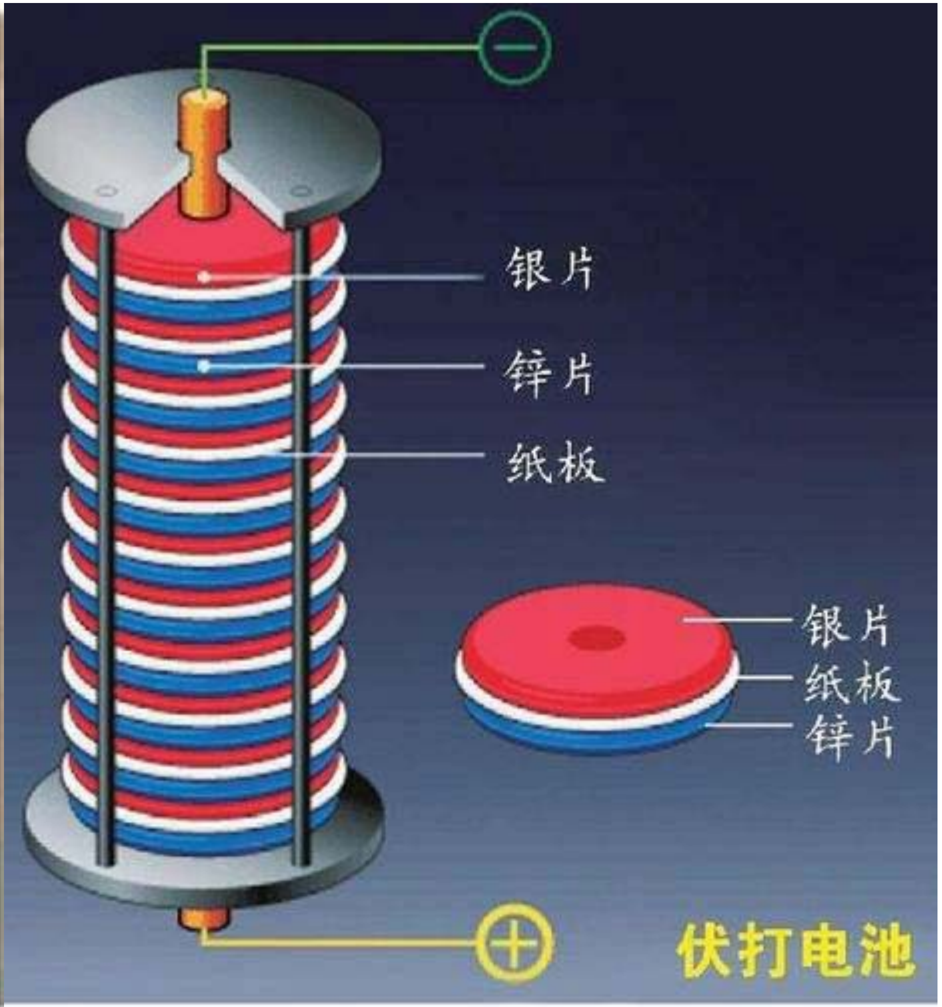
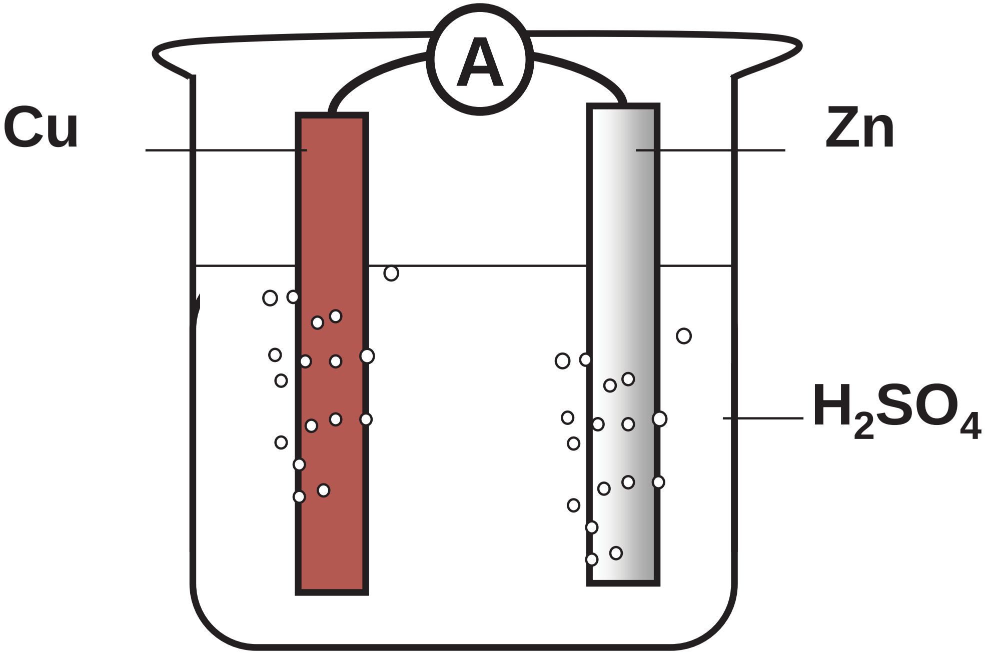
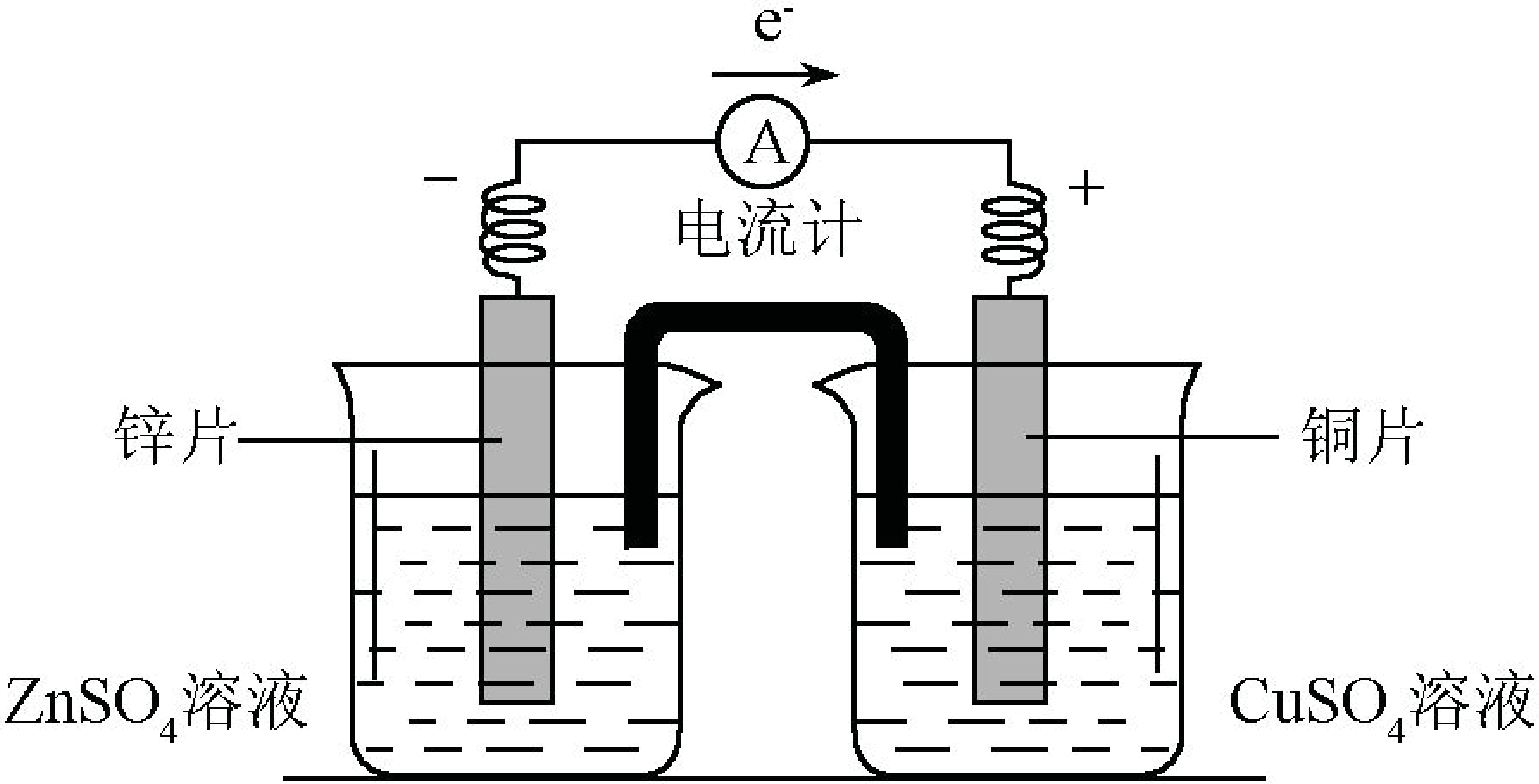
化学电源

蒋闯闯


−
银片
锌片
纸板
银片
纸板
锌片
+
伏打电池


Cu
A
Zn
H_2SO_4

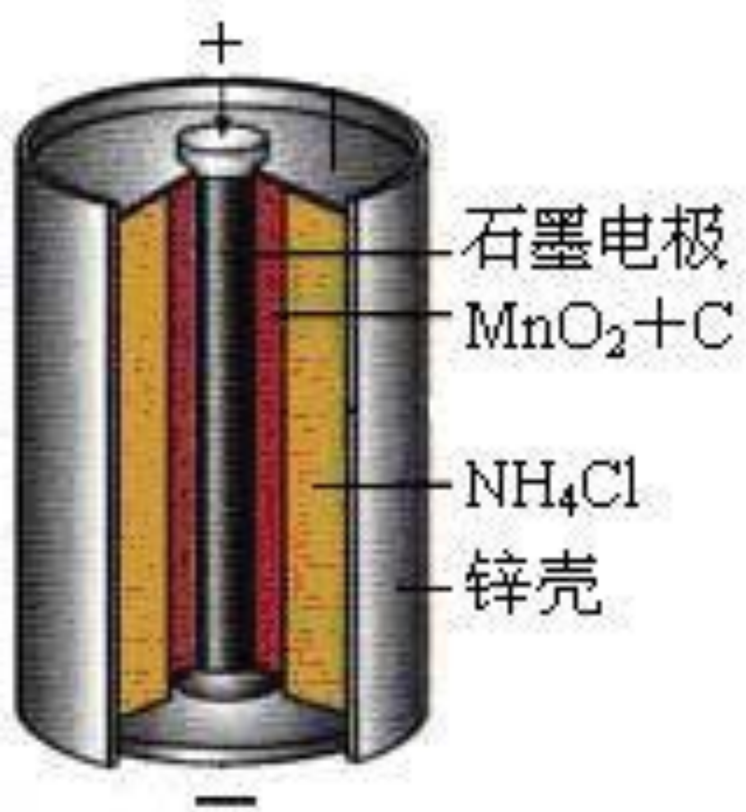
1836英国丹尼尔



锌铜原电池装置

1860年法国富克兰士--锌锰湿电池

1887年英国赫勒森--干电池

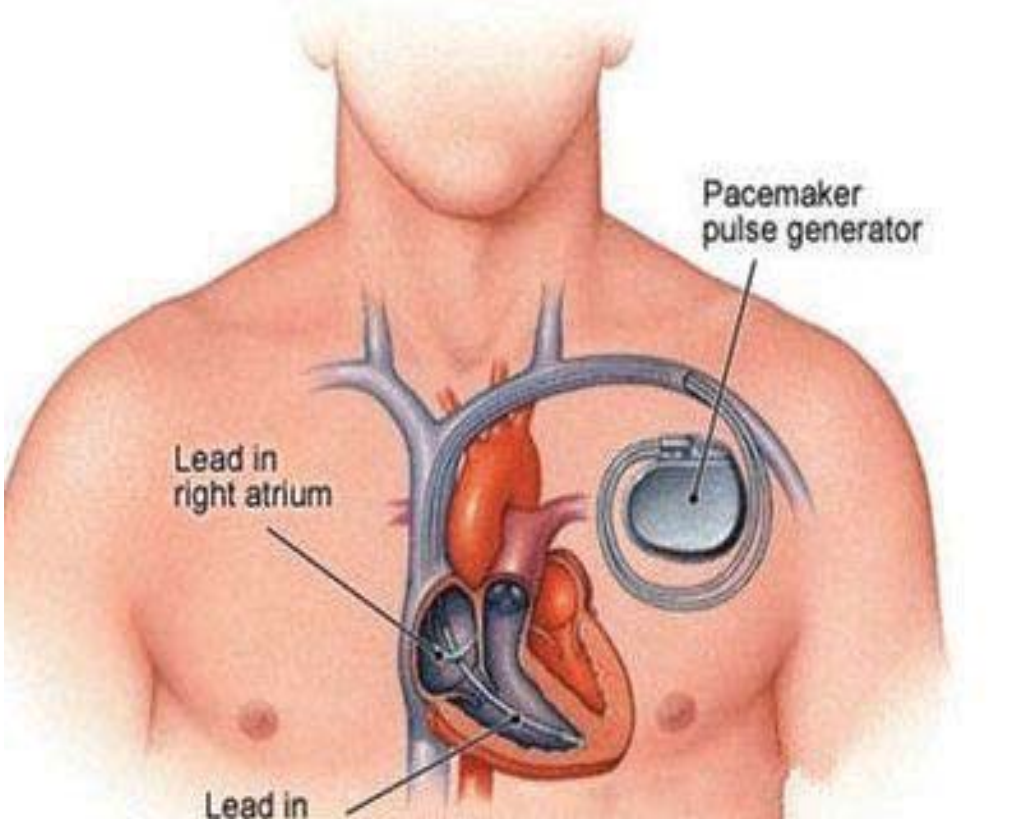


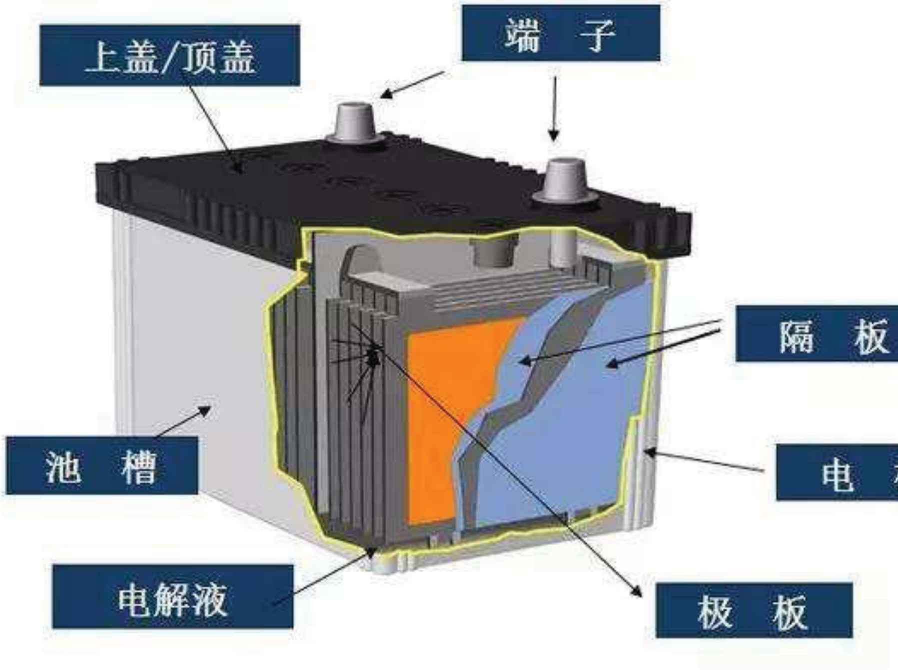
锌锰电池的构造

碱性锌锰电池的构造


377
SR626SW
+
Silver Oxide
http://www.clnsz.com

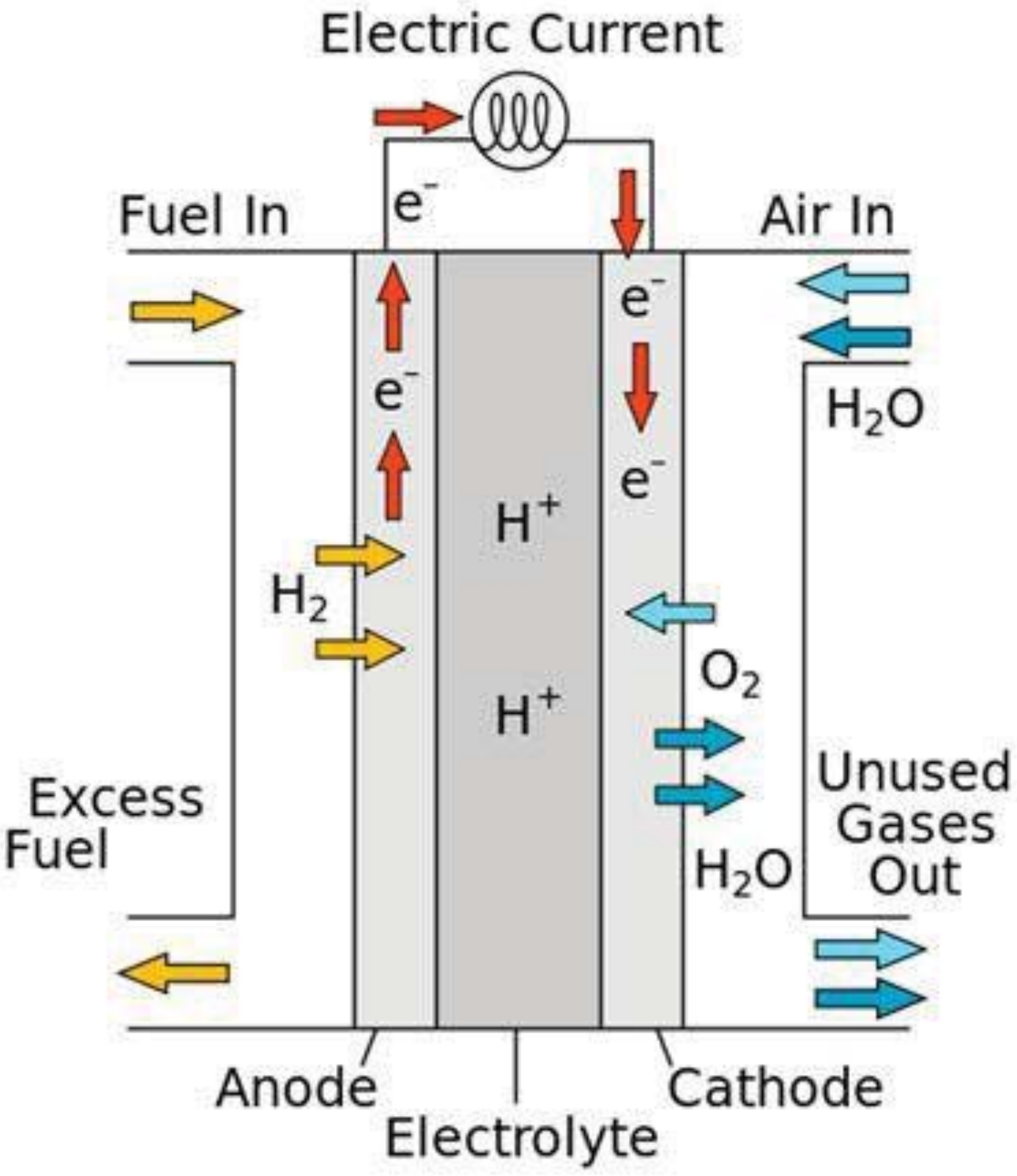

苏宁易购
8:16

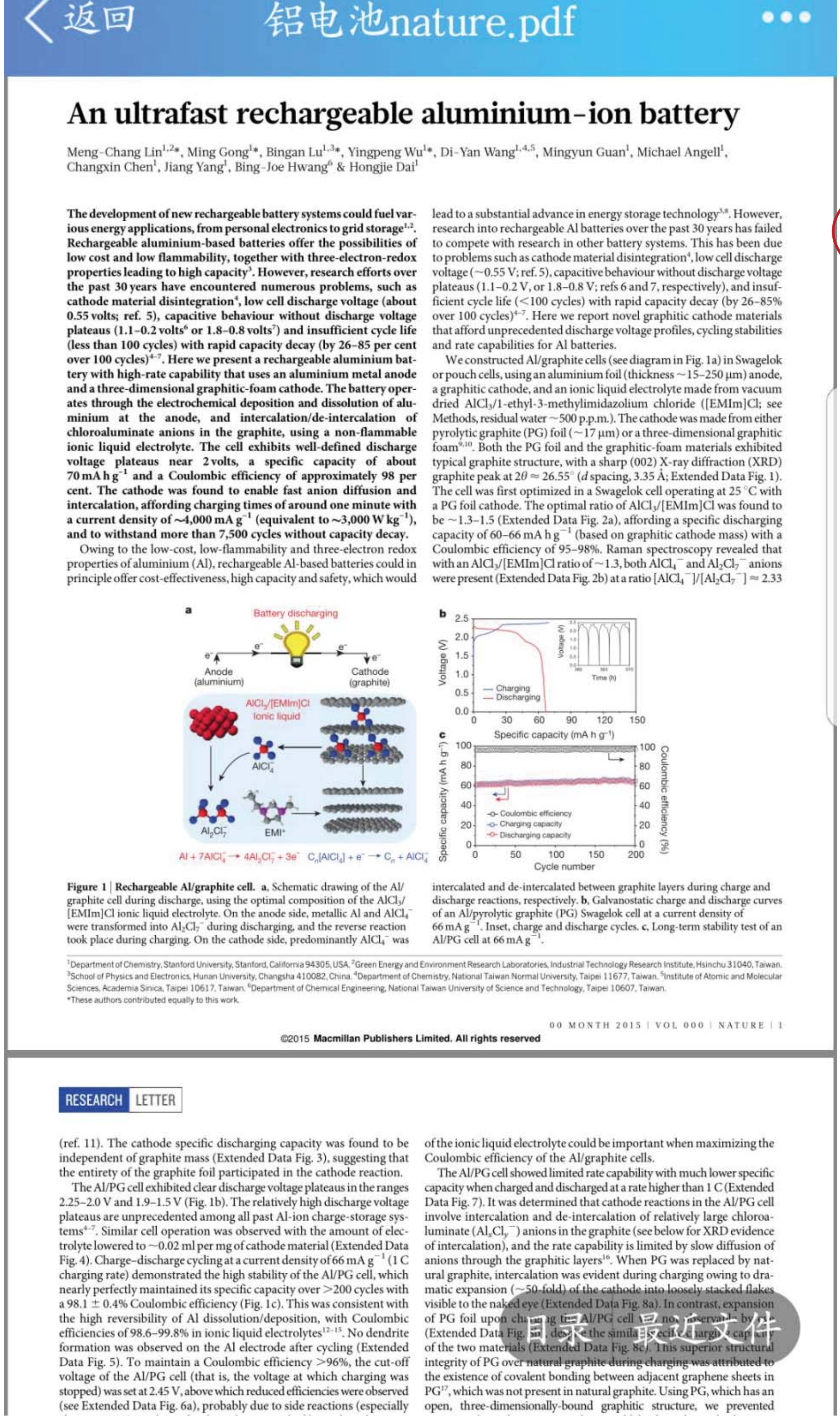

Pacemaker pulse generator
Lead in right atrium
Lead in


上盖/顶盖
端　子
隔　板
池　槽
电　槽
电解液
极　板


SPRINT

1948年英国葛洛夫--燃料电池





An ultrafast rechargeable aluminium-ion battery

Meng-Chang Lin[1,2*], Ming Gong[1*], Bingan Lu[1,3*], Yingpeng Wu[1*], Di-Yan Wang[1,4,5], Mingyun Guan[1], Michael Angell[1], Changxin Chen[1], Jiang Yang[1], Bing-Joe Hwang[6] & Hongjie Dai[1]

The development of new rechargeable battery systems could fuel various energy applications, from personal electronics to grid storage[1,2]. Rechargeable aluminium-based batteries offer the possibilities of low cost and low flammability, together with three-electron-redox properties leading to high capacity[3]. However, research efforts over the past 30 years have encountered numerous problems, such as cathode material disintegration[4], low cell discharge voltage (about 0.55 volts; ref. 5), capacitive behaviour without discharge voltage plateaus (1.1–0.2 volts[6] or 1.8–0.8 volts[7]) and insufficient cycle life (less than 100 cycles) with rapid capacity decay (by 26–85 per cent over 100 cycles)[4–7]. Here we present a rechargeable aluminium battery with high-rate capability that uses an aluminium metal anode and a three-dimensional graphitic-foam cathode. The battery operates through the electrochemical deposition and dissolution of aluminium at the anode, and intercalation/de-intercalation of chloroaluminate anions in the graphite, using a non-flammable ionic liquid electrolyte. The cell exhibits well-defined discharge voltage plateaus near 2 volts, a specific capacity of about 70 mA h g^{-1} and a Coulombic efficiency of approximately 98 per cent. The cathode was found to enable fast anion diffusion and intercalation, affording charging times of around one minute with a current density of ~4,000 mA g^{-1} (equivalent to ~3,000 W kg^{-1}), and to withstand more than 7,500 cycles without capacity decay.

Owing to the low-cost, low-flammability and three-electron redox properties of aluminium (Al), rechargeable Al-based batteries could in principle offer cost-effectiveness, high capacity and safety, which would lead to a substantial advance in energy storage technology[3,8]. However, research into rechargeable Al batteries over the past 30 years has failed to compete with research in other battery systems. This has been due to problems such as cathode material disintegration[4], low cell discharge voltage (~0.55 V; ref. 5), capacitive behaviour without discharge voltage plateaus (1.1–0.2 V, or 1.8–0.8 V; refs 6 and 7, respectively), and insufficient cycle life (<100 cycles) with rapid capacity decay (by 26–85% over 100 cycles)[4–7]. Here we report novel graphitic cathode materials that afford unprecedented discharge voltage profiles, cycling stabilities and rate capabilities for Al batteries.

We constructed Al/graphite cells (see diagram in Fig. 1a) in Swagelok or pouch cells, using an aluminium foil (thickness ~15–250 μm) anode, a graphitic cathode, and an ionic liquid electrolyte made from vacuum dried $AlCl_3$/1-ethyl-3-methylimidazolium chloride ([EMIm]Cl; see Methods, residual water ~500 p.p.m.). The cathode was made from either pyrolytic graphite (PG) foil (~17 μm) or a three-dimensional graphitic foam[9,10]. Both the PG foil and the graphitic-foam materials exhibited typical graphite structure, with a sharp (002) X-ray diffraction (XRD) graphite peak at $2\theta \approx 26.55°$ (*d* spacing, 3.35 Å; Extended Data Fig. 1). The cell was first optimized in a Swagelok cell operating at 25 °C with a PG foil cathode. The optimal ratio of $AlCl_3$/[EMIm]Cl was found to be ~1.3–1.5 (Extended Data Fig. 2a), affording a specific discharging capacity of 60–66 mA h g^{-1} (based on graphitic cathode mass) with a Coulombic efficiency of 95–98%. Raman spectroscopy revealed that with an $AlCl_3$/[EMIm]Cl ratio of ~1.3, both $AlCl_4^-$ and $Al_2Cl_7^-$ anions were present (Extended Data Fig. 2b) at a ratio $[AlCl_4^-]/[Al_2Cl_7^-] \approx 2.33$

Figure 1 | Rechargeable Al/graphite cell. **a**, Schematic drawing of the Al/graphite cell during discharge, using the optimal composition of the $AlCl_3$/[EMIm]Cl ionic liquid electrolyte. On the anode side, metallic Al and $AlCl_4^-$ were transformed into $Al_2Cl_7^-$ during discharging, and the reverse reaction took place during charging. On the cathode side, predominantly $AlCl_4^-$ was intercalated and de-intercalated between graphite layers during charge and discharge reactions, respectively. **b**, Galvanostatic charge and discharge curves of an Al/pyrolytic graphite (PG) Swagelok cell at a current density of 66 mA g^{-1}. Inset, charge and discharge cycles. **c**, Long-term stability test of an Al/PG cell at 66 mA g^{-1}.

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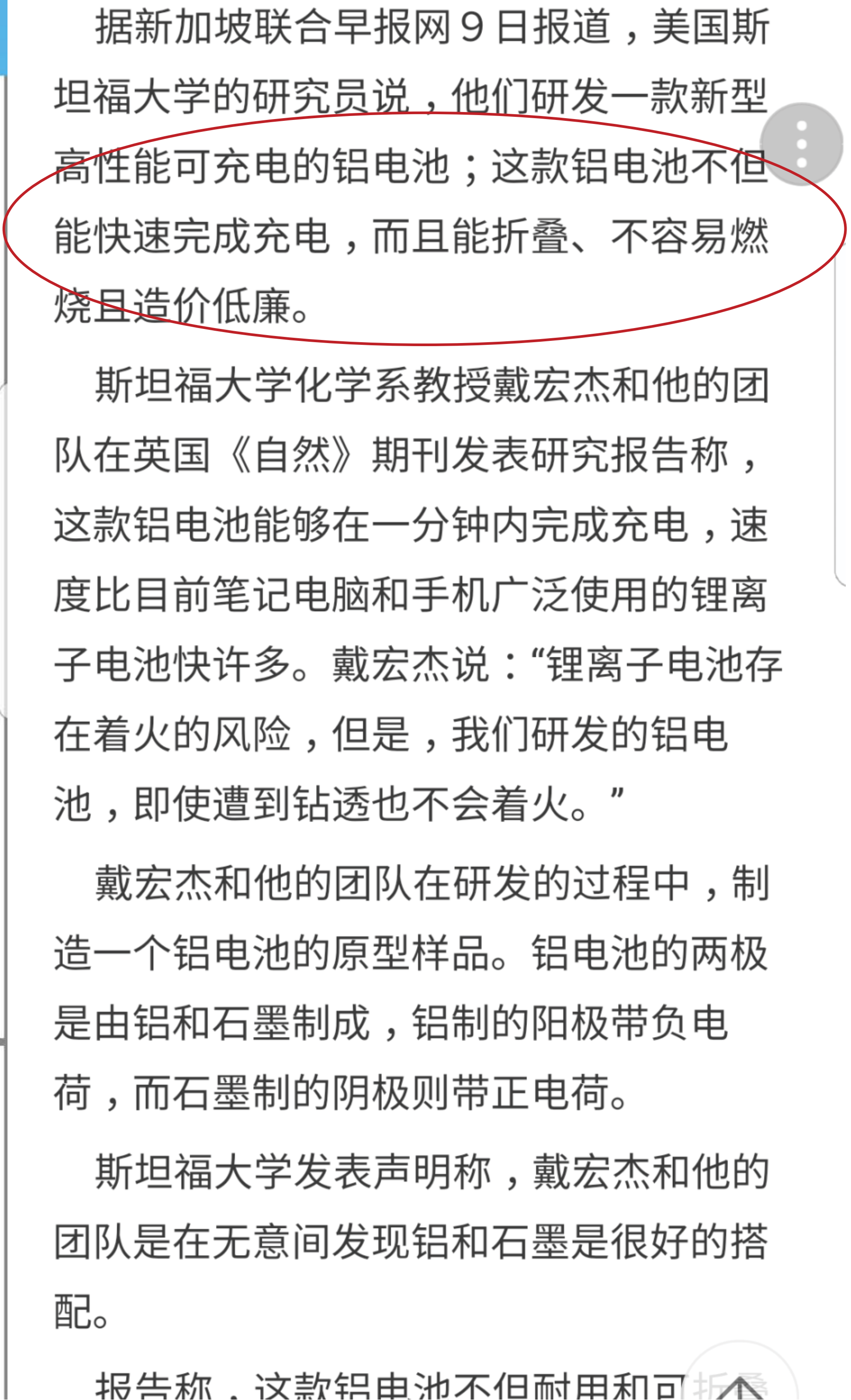
(ref. 11). The cathode specific discharging capacity was found to be independent of graphite mass (Extended Data Fig. 3), suggesting that the entirety of the graphite foil participated in the cathode reaction.

The Al/PG cell exhibited clear discharge voltage plateaus in the ranges 2.25–2.0 V and 1.9–1.5 V (Fig. 1b). The relatively high discharge voltage plateaus are unprecedented among all past Al-ion charge-storage systems[4–7]. Similar cell operation was observed with the amount of electrolyte lowered to ~0.02 ml per mg of cathode material (Extended Data Fig. 4). Charge–discharge cycling at a current density of 66 mA g^{-1} (1 C charging rate) demonstrated the high stability of the Al/PG cell, which nearly perfectly maintained its specific capacity over >200 cycles with a 98.1 ± 0.4% Coulombic efficiency (Fig. 1c). This was consistent with the high reversibility of Al dissolution/deposition, with Coulombic efficiencies of 98.6–99.8% in ionic liquid electrolytes[12–15]. No dendrite formation was observed on the Al electrode after cycling (Extended Data Fig. 5). To maintain a Coulombic efficiency >96%, the cut-off voltage of the Al/PG cell (that is, the voltage at which charging was stopped) was set at 2.45 V, above which reduced efficiencies were observed (see Extended Data Fig. 6a), probably due to side reactions (especially of the ionic liquid electrolyte could be important when maximizing the Coulombic efficiency of the Al/graphite cells.

The Al/PG cell showed limited rate capability with much lower specific capacity when charged and discharged at a rate higher than 1 C (Extended Data Fig. 7). It was determined that cathode reactions in the Al/PG cell involve intercalation and de-intercalation of relatively large chloroaluminate ($Al_xCl_y^-$) anions in the graphite (see below for XRD evidence of intercalation), and the rate capability is limited by slow diffusion of anions through the graphitic layers[16]. When PG was replaced by natural graphite, intercalation was evident during charging owing to dramatic expansion (~50-fold) of the cathode into loosely stacked flakes visible to the naked eye (Extended Data Fig. 8a). In contrast, expansion of PG foil upon charging the Al/PG cell was not observable by eye (Extended Data Fig. [illegible]), despite the similar specific charging capacity of the two materials (Extended Data Fig. 8c). This superior structural integrity of PG over natural graphite during charging was attributed to the existence of covalent bonding between adjacent graphene sheets in PG[17], which was not present in natural graphite. Using PG, which has an open, three-dimensionally-bound graphitic structure, we prevented



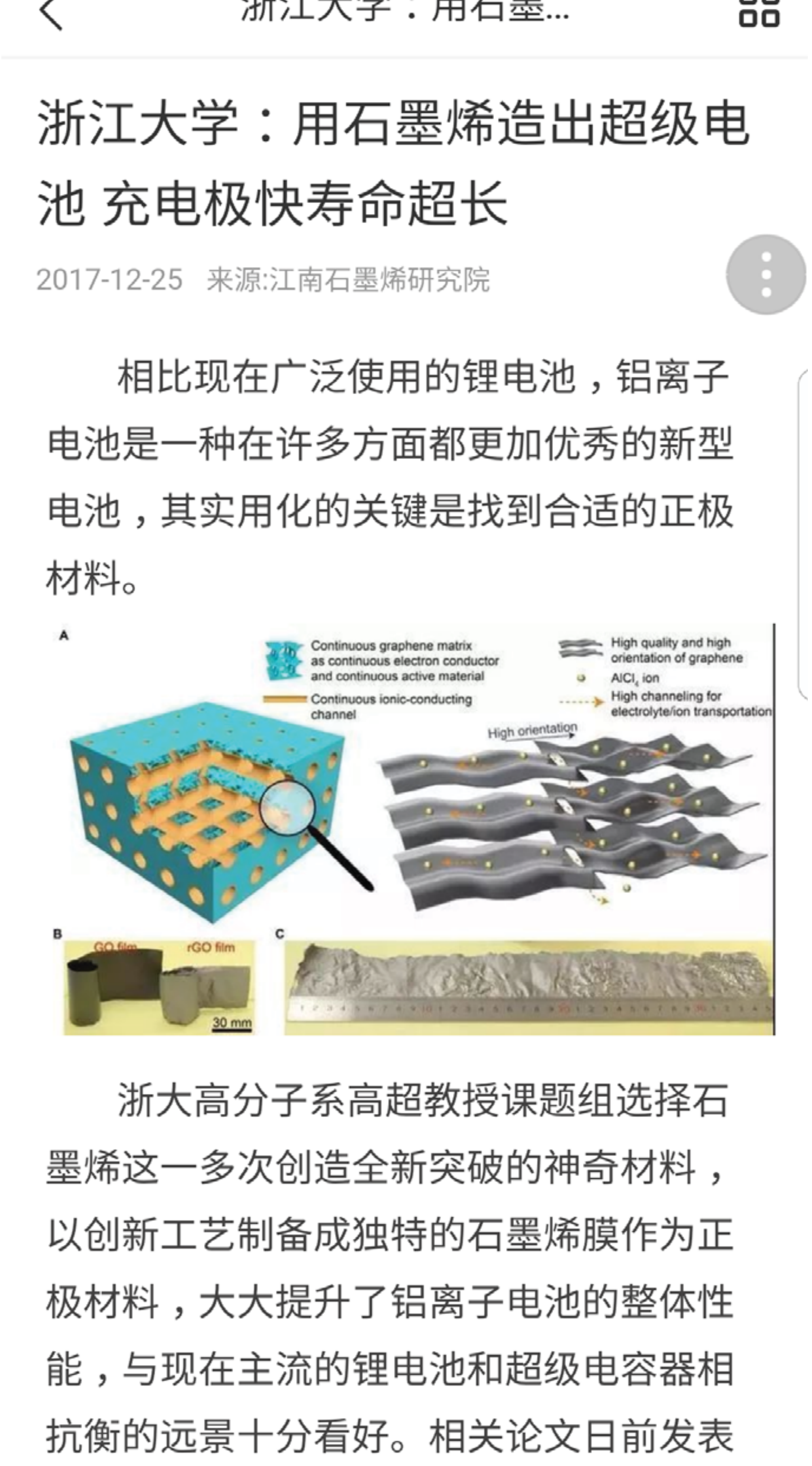
据新加坡联合早报网9日报道，美国斯坦福大学的研究员说，他们研发一款新型高性能可充电的铝电池；这款铝电池不但能快速完成充电，而且能折叠、不容易燃烧且造价低廉。

斯坦福大学化学系教授戴宏杰和他的团队在英国《自然》期刊发表研究报告称，这款铝电池能够在一分钟内完成充电，速度比目前笔记电脑和手机广泛使用的锂离子电池快许多。戴宏杰说：“锂离子电池存在着火的风险，但是，我们研发的铝电池，即使遭到钻透也不会着火。”

戴宏杰和他的团队在研发的过程中，制造一个铝电池的原型样品。铝电池的两极是由铝和石墨制成，铝制的阳极带负电荷，而石墨制的阴极则带正电荷。

斯坦福大学发表声明称，戴宏杰和他的团队是在无意间发现铝和石墨是很好的搭配。

报告称，这款铝电池不但耐用和可折叠



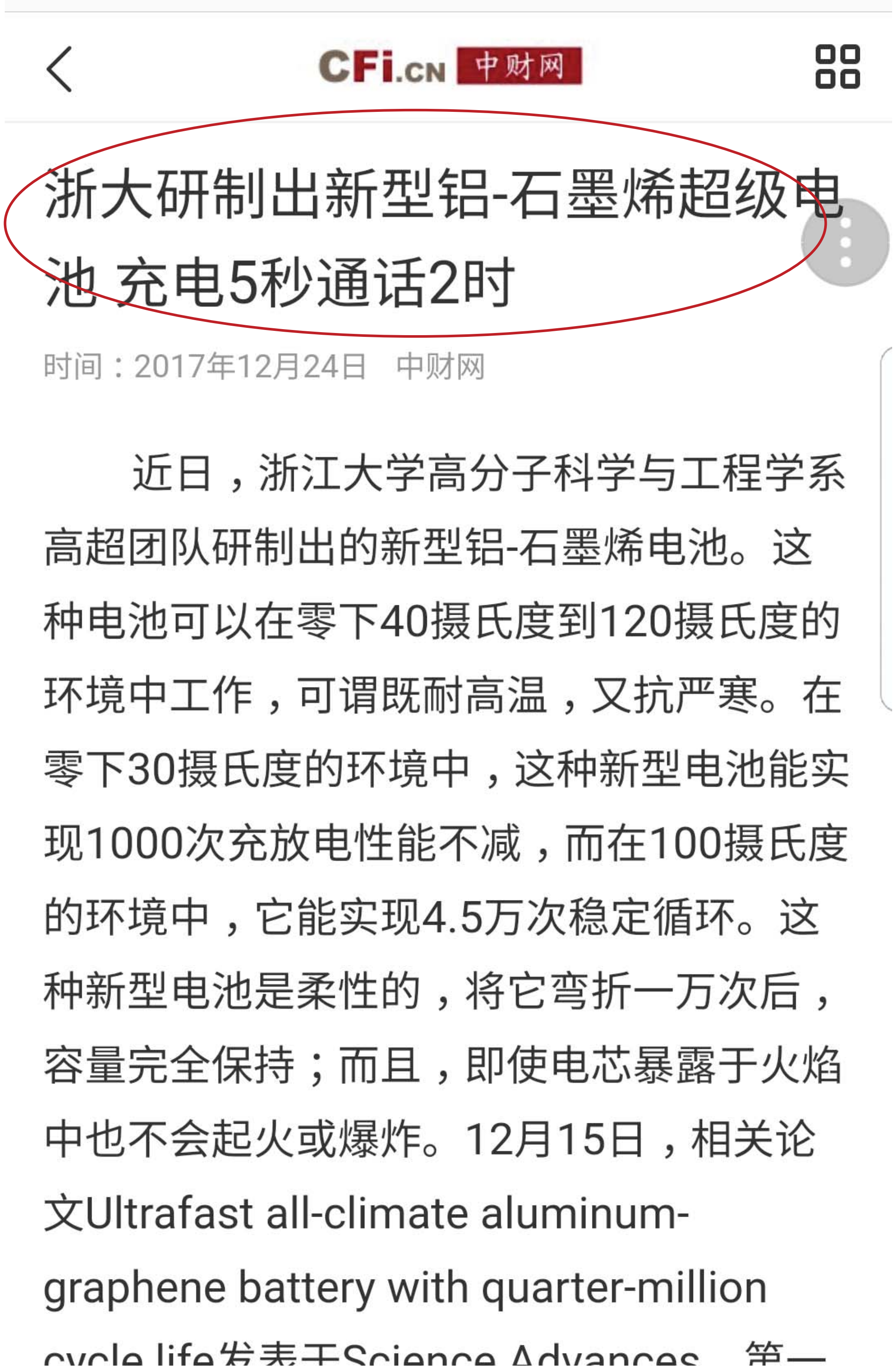
浙江大学：用石墨...

浙江大学：用石墨烯造出超级电池 充电极快寿命超长

2017-12-25 来源:江南石墨烯研究院

相比现在广泛使用的锂电池，铝离子电池是一种在许多方面都更加优秀的新型电池，其实用化的关键是找到合适的正极材料。

浙大高分子系高超教授课题组选择石墨烯这一多次创造全新突破的神奇材料，以创新工艺制备成独特的石墨烯膜作为正极材料，大大提升了铝离子电池的整体性能，与现在主流的锂电池和超级电容器相抗衡的远景十分看好。相关论文日前发表



CFi.CN 中财网

浙大研制出新型铝-石墨烯超级电池 充电5秒通话2时

时间：2017年12月24日 中财网

近日，浙江大学高分子科学与工程学系高超团队研制出的新型铝-石墨烯电池。这种电池可以在零下40摄氏度到120摄氏度的环境中工作，可谓既耐高温，又抗严寒。在零下30摄氏度的环境中，这种新型电池能实现1000次充放电性能不减，而在100摄氏度的环境中，它能实现4.5万次稳定循环。这种新型电池是柔性的，将它弯折一万次后，容量完全保持；而且，即使电芯暴露于火焰中也不会起火或爆炸。12月15日，相关论文Ultrafast all-climate aluminum-graphene battery with quarter-million cycle life发表于Science Advances，第一


2018
幸福
都是奋斗出来的