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A redox fuel cell capable of converting fuels to electricity at a high power output

The use of hydrogen peroxide in fuel cells has recently received increasing attention, primarily due to its several unique characteristics when compared with the use of gaseous oxygen. However, there are three issues associated with the use of hydrogen peroxide in fuel cells. Firstly, the actual cathode potential is lower than the theoretical one, which is mainly attributed to the mixed potential resulting from the simultaneous hydrogen peroxide oxidation reaction on the cathode. Secondly, the hydrogen peroxide oxidation reaction releases gaseous oxygen, leading to a two-phase mass transport. Thirdly, the reduction of hydrogen peroxide in fuel cells has to use metal catalysts, such as platinum, palladium and gold. In this work, we propose to create the cathode potential by introducing a redox couple to the cathode while to use hydrogen peroxide to chemically charge to redox ions, as illustrated. The redox cathode not only completely eliminates the mixed-potential problem associated with the direct reduction of hydrogen peroxide, but also enables a faster cathodic electrochemical kinetics even without noble metal catalysts. It has been demonstrated that the fuel cell running on ethanol with a redox couple of V(IV)/V(V) yields a peak power density of 450 mW cm^{-2} at 60°C, which is 87.5% higher than that of the conventional cell with direct reduction of hydrogen peroxide.

Biography

Liang An received PhD degree in Mechanical Engineering from The Hong Kong University of Science and Technology. He is currently an Assistant Professor in Department of Mechanical Engineering at The Hong Kong Polytechnic University. He has authored and co-authored more than 60 journal papers. His research interests include advanced energy conversion and storage technologies, such as fuel cells and flow batteries.

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