Synthesis of Alloy Nanowire Array Electrode for Wearable Direct Urea Fuel Cell

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Wearable devices are now very popular and are used widely in health monitoring and sports training. To address the problem of limited battery life of devices, self-powered energy harvesting wearable devices are being investigated. Our energy harvesting device, direct urea fuel cell (DUFC), aims at generating electricity by using urea in sweat. A Ni-doped ZnCu@Cu alloy-based orderly aligned nanorod array anode is integrated with a CQD-Carbon electrode and assembled on a flexible hydrogel substrate. Based on the oxidation of urea over the Ni-doped ZnCu@Cu alloy-based catalyst and reduction of oxygen at air electrode, a direct urea fuel cell is formed to generate a stable electricity supply. Cu(OH)2 aligned nanorods were grown on the Cu-foam by immersing Cu-foam in alkaline (NH4)2S2O8 solution, followed by chemical reduction to give Cu nanorod array. Cu nanorod array was then electroplated with Zn in alkaline Zn(OH)42+ and doped with Ni, followed by annealing. Nanostructured morphology and chemical composition were examined by SEM and EDX analyses. Our device is fabricated via a combination of lithographically-patterned circuit framework together with anode and cathode array arranged in an island-bridge configuration. The effects of temperature, urea concentration and pH conditions on DUFC performance were investigated. The device exhibits an open circuit voltage of 0.720 V, power density of 12.1 mW cm−2, capacity of 34 mAh and energy capacity of 15 mWh when sweat was used as fuel, air as oxidant at 25 degrees Celcius. This shows that the development of a self-powered energy harvesting wearable direct urea fuel cell is possible.