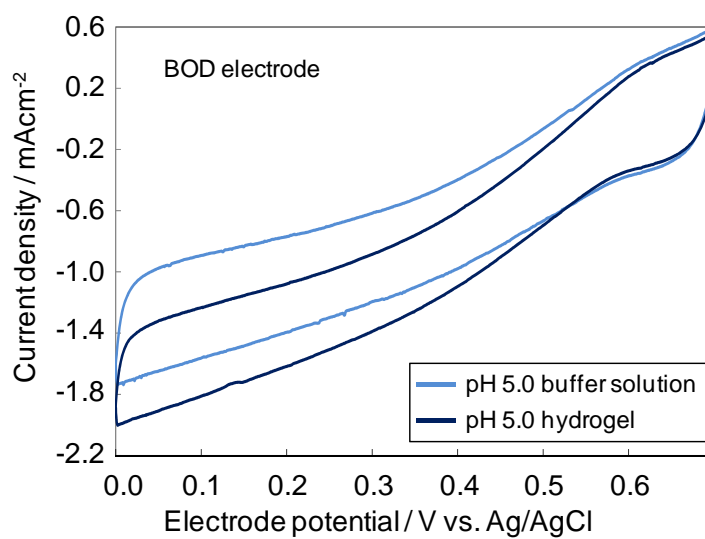
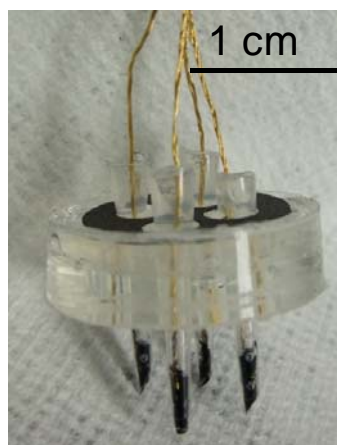


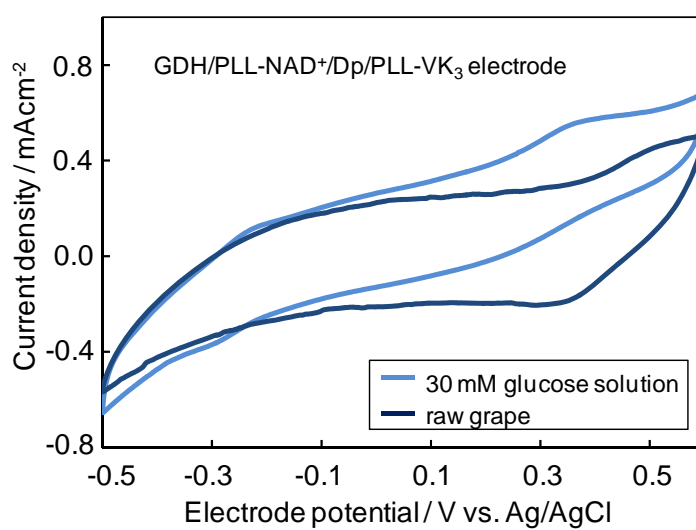
**Supplementary Figure S1.** Fabrication of needles having side pores.



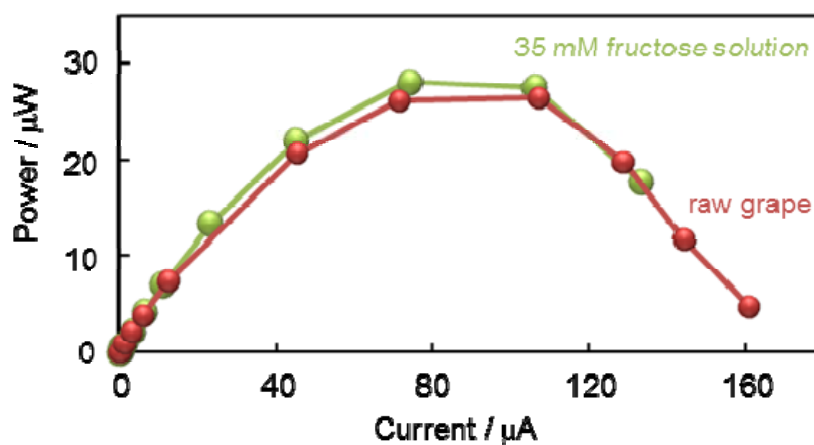
**Supplementary Figure S2.** Cyclic voltammograms of KB/BOD/KB electrodes in pH 5 buffer and hydrogel at 10 mV s<sup>-1</sup>.



**Supplementary Figure S3.** Photograph of the biofuel cell that consists of four needle anodes.



**Supplementary Figure S4.** Cyclic voltammograms of GDH/PLL-NAD<sup>+</sup>/Dp/PLL-VK<sub>3</sub> electrodes at 10 mV s<sup>-1</sup> in 30 mM glucose-containing phosphate buffer (pH 7) and in raw grape (pH5~6).



**Supplementary Figure S5.** Power curve of the miniature biofuel cell (arrayed 4 anodes) taken in a 35 mM fructose experimental solution and in a raw grape berry.