NOVEL REVERSE ELECTRODIALYSIS BIOBATTERY

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Biobatteries offer the potential for a continuous, implantable source of power. A primary area of focus for biobatteries in recent years is the use of glucose oxidase immobilized enzymes. In this reaction the glucose oxidase reduces glucose to gluconic acid (along with a hydrolysis step) where a free electron can be captured. While in theory this enzyme has the potential to produce power for long periods of time inside of the body, in practice the immobilized enzyme breaks down over the course of anywhere from hours to days. Therefore, there is a need to explore other technologies to realize the goal of a long term biobattery. The objective of this research was to use a completely new approach to biobatteries by using Gibbs Free Energy of Mixing between a low concentration and a high concentration stream to generate power. Within the body, the blood in the renal vein is reduced in ions (low concentrations) due to the waste removal function of the kidneys. Thus mixing the renal vein's blood with blood in another vein can produce power by reverse electrodialysis (RED). The RED-based biobattery has a power density on the same order of magnitude as the best glucose oxidase biobatteries. Furthermore, the RED-based biobattery was operated for several weeks with little loss in power.