Harvesting Energy Directly from Agricultural Products

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Energy harvesting from biomass is currently of great interest to researchers. This is because biomass is a renewable energy resource. Energy harvesting from biomass often involves chemical reactions, such as combustion reactions and redox reactions mediated by anaerobic bacteria. These chemical reactions require deliberately created specific conditions to occur. In other words, when the reaction conditions are not met, the chemical reactions will not occur, and no energy will be harvested. Therefore, we consider harvesting energy directly from biomass. Agricultural products are common biomass. The chemical properties, such as pH, of different agricultural products vary. Therefore, when two different agricultural products are connected, a potential difference will be generated between them. Energy can be harvested directly utilizing this potential difference.

In this paper, the potential difference between orange, apple, lemon, potato, and banana were measured with identical graphite electrodes. The largest potential differences were found at the orange-apple junction, which is around 0.26 V to 0.27 V. However, the current in the orange-apple junction is negligible, likely due to the high impedance caused by the membrane structures within the fruit. To investigate the effect of these membranes on resistance, we compared the resistance of smashed fruits (with disrupted membranes) to non-smashed fruits (with intact membranes). The smashed fruits exhibited significantly lower resistance, almost half that of the non-smashed fruits. We also attempted to reduce the overall resistance by connecting 12 orange-apple junctions in parallel; but the total current remained negligible.

To assess the feasibility of using agricultural products as a source for energy harvesting, a supercapacitor (2.7 V, 3.3 F) was connected in series with 12 orange-apple junctions for 24 hours. Initially, the voltage of the supercapacitor was 0 V, and after 24 hours of charging, it reached 250 mV. This indicates that agricultural products can indeed be used as a viable energy source for harvesting.

This study has the potential to power sensors that require minimal electrical energy, making them suitable for remote areas. This capability can help avoid the need for frequent battery replacements, thereby reducing environmental pollution.