Abstract

With the advances in electronics, a large number of electronic appliances and applications are developed for field applications, power sources for such applications has been of much interest now a days. Batteries are routinely used as power sources, but they have the serious drawback of limited recharge cycles. Solar power along with battery is used now a day for powering field applications. But here also the problem of battery exists. Here we examine the use of fuel cell as a sustainable power source for powering field deployed electronic applications.

Micro-SOFC model was created using COMSOL Multiphysics® with hydrogen anode fuel. The O^{2-} ion transport properties were modelled and the model was validated with the experimentally reported data. Post validation, this model was employed to model the effects of hydrocarbon anode fuels on the O^{2-} ion transport properties. It was remarked that the transport is hampered due to the formation of GIIB at the EEI because of CO2 being a by-product in the electrochemical reaction taking place in the reaction sites present in the EEI as we change to low H: C ratio anode fuels.

Nanopowdered rice husk based nano-gasifier cum catalytic reformer has been proposed to function as a solid organic / biomass anode fuel substitute to be utilized in portable devices with μ-SOFC which will work as a self-sustainable uninterruptable power source. It is noted from the TG/DTA analysis that, nanopowdered rice husk is more efficient combusted than the raw rice husk since the surface to volume ratio gets increased, likewise it is understood that it is compact and uses up less space. On gasification of the nanopowdered rice husk, it produced syngas, which mainly constituted CO_2 and could create performance issues with the μ-SOFC. Inorder to avoid such fatal situations, a Nano catalytic reformer is being utilized in conjunction with the nano-gasifier which breakdowns CO_2 to CO.

A scheme for in-vivo power generation has been proposed for powering various body implants using waste body fluids based on nano biofuel cell. These waste fluids constitute waste glucose, which is decomposed to high H:C ratio alcohols using bioenzymes. These alcohols serve as the anode fuel for the nano biofuel cell. Further, this whole power generation system is enclosed in a biocompatible packaging material. This material was examined for both Hemolysis and Cytotoxicity which confirmed it to be biocompatible as per the FDA limit.

Ultra-portable μ-SOFC testing setup was fabricated using machined graphite as the high temperature chamber. Novel design was used to machine this graphite chamber. It has embedded microheater to raise its temperature from 1000˚C which is needed for the operation of a μ-SOFC. Both the anode and cathode fuels are fed using portable canisters to benchmark the performance of the μ-SOFC. It was observed that the μ-SOFC (ASC-2.0) had poor performance for syngas anode fuel because of the CO_2 presence resulting in the formation of GIIB. Biomethane, methane and propane anode fuels also showed the GIIB impact, but not so much significant as when syngas anode fuel was fed.