leads to a rapid oxidation of the Si nanocrystallites (nc-Si). The diffusion of oxygen (substituted to Si–H in immersion process) in the inner of nc-Si modify the crystallite size which explain the instability of the luminescence under temperature variation. In the case of PS/Co sample, two different mechanisms were proposed; one is the desorption of $Si\text{-}H_{x(x=2,3)}$ with the formation of cobalt oxide for annealing temperature less than 450°C which cause the increasing of PL intensity and the stability of PL energy, the other mechanism is the transformation of the porous silicon to silica at high temperatures (> 500°C) [6] which leads to the decreasing of the PL intensity and the blue shift of the PL curve.

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DEFC SCALING UP SIMULATIONS

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Keywords: DEFC, scale up, simulation, CFD

Abstract

The scaling up process in fuel cells is one of the main steps to obtain a commercial fuel cell. The use of computational simulations for many operational conditions allows the optimization of these conditions and in this way, it can help to determine, for example, the best temperature, humidity and flow rates, required to achieve minimal performance losses and to achieve high efficiencies[1, 2].

The results of numerical simulations for the scaling up[3] from 5 cm^2 to 144 cm^2 geometric area of a DEFC (Direct Ethanol Fuel Cell) are presented in this work. The CFD simulations were performed using the COMSOL software and 5 cm^2 experimental data obtained at the Fuel Cell and Hydrogen Laboratories at IPEN-Institute for Nuclear and Energy Research[4].

The operational parameters implemented in the simulations were: range of temperature: 80°C – 110°C, ethanol flux: 2 mL min^{-1}, permeability of diffusion layer: 1.0 10^{-13} m^2, and oxygen as cathode gas.

The diffusion layer physics were implemented in the Brinkman Equations Chemical Engineering COMSOL Module. The z-velocity was the concerned parameter, since this gas velocity represents the velocity that the gas permeates the porous layer in the MEA (Membrane Electrode Assembly).

The considerations related with the 5 cm^2 fuel cell were: steady state analysis, 53,266 tetrahedral elements mesh, 295,505 degrees of freedom and SPOOLES direct linear solver. With relation to the 144 cm^2, the parameters were: steady state analysis, 81,118 tetrahedral elements mesh, 459,331 degrees of freedom and the same linear direct solver.

There are 16-parallel and 4-serpentine channels composing the 5 cm^2 flow channel plate while for the 144 cm^2 there are 60-parallel and 5-serpentine channels.

It was observed that for the 5 cm^2 fuel cell, v_z = 1.56 10^{-5} m s^{-1} and p = 6.37 103 μN, compared to the values for the 144 cm^2, v_z = 9.82 10^{-10} m s^{-1} and p = 7.25 μN.

These results were obtained under the same boundary conditions: 80°C, input flux of 2 mL min^{-1} of ethanol vapor and zero output pressure in the porous layer.

It was noticed a non-linear behavior of the simulated results in relation to the increase of the proposed scales. With this data, it was expected a better performance related to the 5 cm^2 fuel cell, indicating the necessity of optimization of the input flux, the permeability of the porous layer and the operation temperature, to achieve higher active area fuel cells.

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THERMODYNAMIC INVESTIGATION OF STEAM-AIR GASIFICATION OF DATE PALM AND OLIVE BY-PRODUCTS

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Keywords: biomass, gasification, olive waste, date palm residue, hydrogen

Abstract

Biomass energy is the oldest known renewable energy that humans have been using. Now with the increase in oil price and the environment impacts it appears as one suitable solution of these problems. Biomass gasification has attracted the highest interest amongst the thermochemical conversion technologies (combustion, pyrolysis) as it produces a gas that can be used for the production of power, heat, liquid fuels and hydrogen.

Tunisia has abundant waste providing the exploitation of date palm and the production of olive oil. Over the last few years, many researchers focused on these byproducts as a raw material to produce high value-added such us electricity, biogas, but less attention has been given to the hydrogen production.

This paper presents a thermodynamic investigation of hydrogen production via Tunisian agricultural byproducts gasification. Gibbs energy minimization approach was used to determine the synthesis gas composition. The effects of pressure, steam to biomass ratio (SBR) and equivalence ratio (ER) on the hydrogen yield were studied.

The results indicate that steam-air gasification of olive waste gave higher amount of hydrogen than date palm residues: 62g/kg biomass versus 52g/kg biomass. Moreover, for both feedstocks, the increase of the gasification pressure decreases the hydrogen yield. Besides, it was found that CO_2 and methane production decrease with the Equivalence Ratio and the gasification temperature. The optimum amount of air, maximizing the hydrogen yield, is 2 kg and 1.6 kg per kg of olive waste and palm residues, respectively. With SBR increasing from 0 to 0.3 the hydrogen content in gas product enhanced and reached the maximum value (22% and 21% respectively for olive waste and palm residues).

Finally, our equilibrium calculations were compared with experimental data from literature, which showed that for high gas residence times, and high gasification temperatures there is a close match of equilibrium results with experimental ones.

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ZERO EMISSION VEHICLES BASED ON FUEL CELL. CHALLENGES AND OPPORTUNITIES FOR SUSTAINABLE MOBILITY

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Abstract

Recent analysis from the United Nations Department of Economic and Social Affairs shows that by 2030, 60 percent of the world's population will live in large urban centers [1]. As cities become larger, traffic congestion, energy consumption, carbon emissions, and other forms of pollution are increasing, imposing high costs on local and global economies and impacting quality of life and the environment. Sustainable Mobility is one of the main political strategy of European Union (UE) devised to reach a reduction at least 60% of greenhouse gas emissions by 2050 with respect to 1990 [2]. To achieve this goal new sustainable fuels and powertrain architectures must be developed, the performance of multimodal logistic chains must be optimized and transport infrastructure must be used more