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Development of a Bi-Cell proton exchange membrane fuel cell with optimized groove-designed piezoelectric actuator

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Previous studies demonstrated a piezoelectric proton exchange membrane fuel cell (PZT-PEMFC) stack design composed of three bi-cells in series and a single bi-cell, with a maximum net power density of 0.1608 W cm^{-2}. This study develops an air-breathing pump driven by a piezoelectric actuator to provide oxygen for a proton exchange membrane fuel cell (PEMFC). A groove-designed PZT actuator enclosed with poly-di-methyl-siloxane (PDMS) can reduce uneven air feeding. This actuator can also improve the performance of both sides of a bi-cell, with only a 0.7 % difference in the open-circuit voltage under the PZT actuator within a PDMS diaphragm (PZT-PDMS combination) with 30 min curing time, one side of the single cell had an open-circuit voltage of 0.989 V. According to the analysis of Computational Fluid Dynamics, when the nozzle and diffuser of the air-breathing pump have aspect ratio 13.13, diffuser angle (θ) of 15°, and channel opening width (D) of 1.0 mm, the air flow uniformly distribute over inside of the pump, and then it helps stabile reaction between oxygen and membrane electrode assembly (MEA). The experimental results showed that the net power density of the new version of the single bi-cell PZT-PEMFC module was 0.1658 W cm^{-2}.

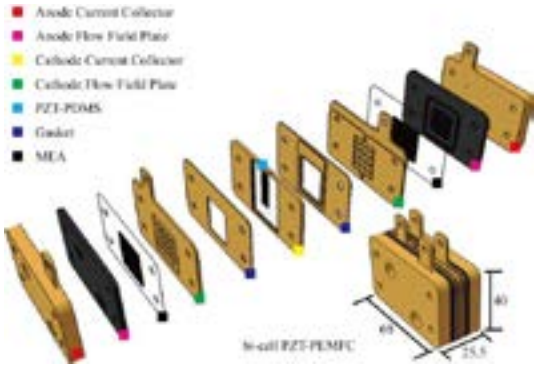

Figure 1: The schematic of the Bi-cell PZTmag-PEMFC stack.

Biography

Yuan-Lung Hsu received his BS and MS degree from National Kaohsiung University of Applied Sciences in 2010 and 2013, respectively. He is currently a PhD candidate in the Department of Mechanical Engineering, National Taiwan University, Taiwan. His research focuses on the development of piezoelectric actuators application in PEMFC.

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