講演番号	177

文献番号	20225177

Light-duty Commercial Vehicle Demonstrator Featuring a Low-cost PCB Fuel Cell

Tom Mason [1)] Vidal Bharath [1)] Puneet Jethani [1)] Jonathan Hall [2)] Stephen Borman [2)] Mike Bassett [2)]

1) Bramble Energy Limited
6 Saatellite Business Village, Fleming Way, Crawley, RH10 9NE, UK

2) MAHLE Powertrain Limited
St. James Mill Road, Northampton, NN5 5TZ, UK (E-mail: jonathan.hall@mahle.com)

KEY WORDS:**fuel cell, balance of plant, fuel cell controller**

Bramble Energy have developed a novel fuel cell stack construction based on printed circuit board (PCB) technology more commonly used in the electronics sector. Early products were air cooled and designed for small-scale stationary energy generation and used in applications such as off-grid telecommunications and security systems. The latest technology development has added liquid-cooling to enable the power densities required for on-vehicle applications, including the automotive sector.

The work presented in this paper, focuses on the application of Bramble Energy's liquid cooled printed circuit board fuel cell (PCBFC) technology, shown in Figure 1, into a light commercial vehicle application. The integration work has been completed by MAHLE Powertrain, and the technology highlights of this work are described, including the optimization of the Balance of Plant (BoP) as well as the flexible fuel cell controller developed.

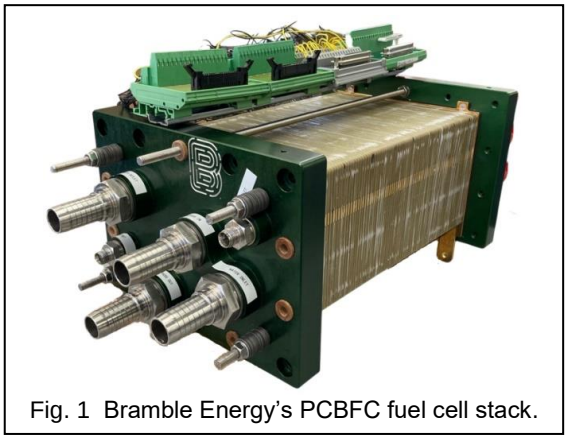

Fig. 1 Bramble Energy's PCBFC fuel cell stack.

Bramble Energy is a UK based fuel cell manufacturer with a highly innovative, low-cost, fuel cell technology that utilizes the global scale and manufacturing of the printed circuit board (PCB) industry. Traditional fuel cell stacks are made up of a multitude of complex components. The simplification in the bill of materials relates directly to the number of failure points within the stack and the number of discrete components required in the manufacture of a PCBFC stack compared to a traditional stack of the same size is reduced by a factor of 3.8. The focus of this work is to develop a working demonstrator vehicle to show that the PCBFC technology is a viable option for automotive applications.

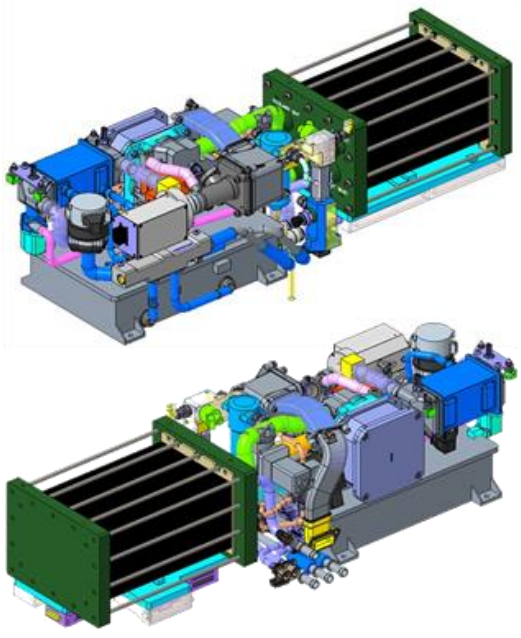

Fig. 2 Front and rear views of the PCBFC system package for the demonstrator vehicle..

The demonstrator vehicle is based on a Renault Kangoo BEV light commercial vehicle platform. The fuel cell system utilises a 10 kW, liquid cooled, PCBFC. The BoP was optimized specifically for this application using one-dimensional (1D) simulation tools to ensure that the cathode airpath components could deliver the airflow rate and pressure necessary to enable the desired power output to be achieved.

MAHLE Powertrain has developed a fuel cell controller, based on the successful family of MAHLE flexible ECU (MFE). The MFE controller has been successfully implemented for internal combustion engines (ICE), hybrid and fully electric vehicles. A range of hardware platforms are used, depending on the I/O requirements and bespoke software logic is written using Simulink.

The fuel cell controller takes care of all aspects of the fuel cell system control, including anode pressure control, purge and injector operation, cathode air supply including flow rate, back pressure and humidity control, electrical load control, cell voltage measurement (CVM), stack performance control, error handling, hydrogen leakage detection, vehicle-side refueling interlocks and system temperature, pressure and humidity monitoring as well as thermal management. Additionally, the controller area network (CAN) system can be configured for all necessary sensors and systems, as well as outputting data to external devices, such as driver information system (DIS).

The 10 kW fuel cell system has been designed to package within the available space within the demonstrator vehicle. The fuel cell stack and all of the BoP was packaged within a small cavity under the load-bed floor immediately behind the seats. To fit the system within this cavity required the BoP to be tightly integrated into a compact unit. The resulting system design can be seen in Figure 2.