DIGIMAN DISSEMINATION

DigiMan

Newsletter

September2019

March 2019

The project was presented during the FCH JU PEMFC development workshop, held in Marseille, France, 5-6 March 2019. This event combined several European projects focused on PEM fuel cell components.

April 2019

DIGIMAN at the 4th Industry 4.0 Summit & Expo, Manchester, UK, gathering senior level executives from the UK manufacturing industry interested in developing their digital strategies.

May 2019

WMG at 2019 IEEE Intl. Conference on Industrial Cyber-Physical Systems (Tapei), state of the art and future perspectives of Industrial Cyber-Physical Systems and Multisensor Fusion and Integration for Intelligent Systems.

June 2019

Digiman at 52nd CIRP Conf. on Manufacturing Systems on advances, research results and industrial improvements in the field of manufacturing systems facing significant and radical societal and technical changes.

August 2019

Warwick Manufacturing Group proceeding on **Automatic PLC Code Generation Based on Virtual Engineering Model**, M. Jbair, B. Ahmad, M. H. Ahmad, D. Vera, R. Harrison, T. Ridler, *ICPS 2019*

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The DIGIMAN partnership involves partners from both academia and industry

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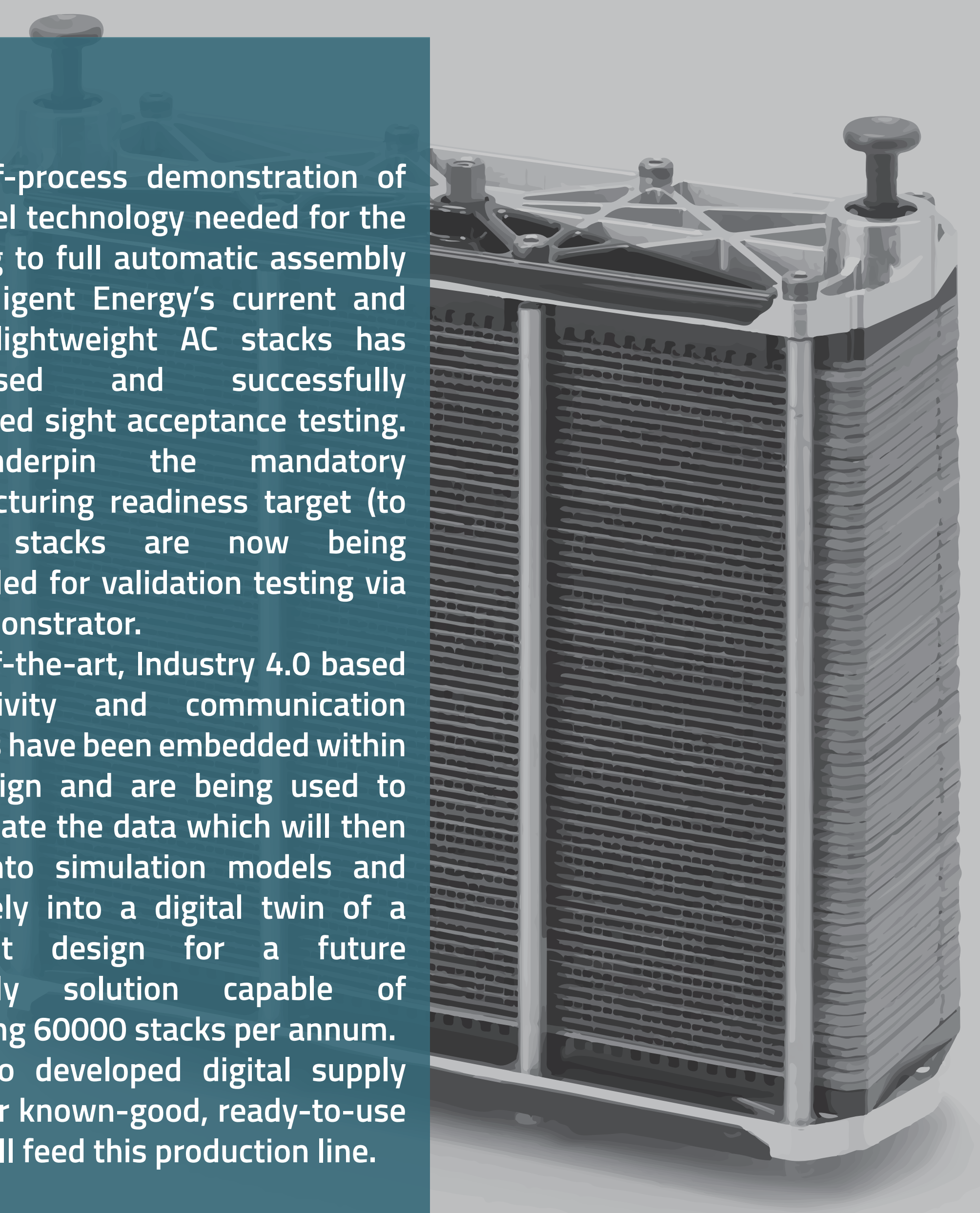


Edito

Proof-of-process demonstration of the novel technology needed for the uplifting to full automatic assembly of Intelligent Energy's current and future lightweight AC stacks has progressed and successfully completed sight acceptance testing. To underpin the mandatory manufacturing readiness target (to MRL6) stacks are now being assembled for validation testing via the demonstrator.
State-of-the-art, Industry 4.0 based connectivity and communication linkages have been embedded within the design and are being used to extrapolate the data which will then input into simulation models and ultimately into a digital twin of a blueprint design for a future assembly solution capable of producing 60000 stacks per annum.
The also developed digital supply chain for known-good, ready-to-use GDLs will feed this production line.

DIGItal MAterials CharacterizatioN Proof-of-Process Auto Assembly

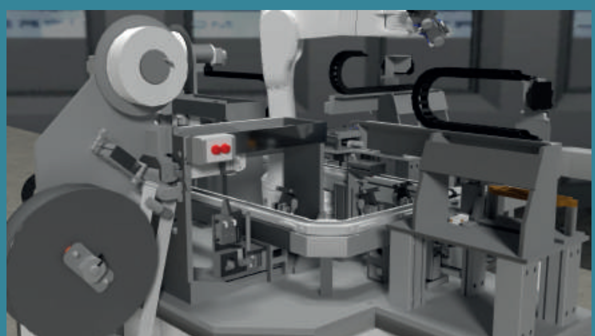
DIGIMAN MAIN ACHIEVEMENTS

WP3 "Digital QC & Converting"

In WP3, the line for camera-based GDL surface inspection and converting was successfully prepared to allow a fully automatized surface inspection. The non-uniformities identified will now be listed in a digital quality protocol that can be exported via various formats after finishing the inspection step (also machine-readable). It is possible to mark the identified areas on the material for most GDL types and various approaches are under evaluation to mark others. Ongoing work also focusses on the extension of a database to include additional inline quality data, such as area weights and others.

To identify boundary conditions for non-uniformities, special laboratory samples were designed to contain non-uniformities in various extents. Upon stack testing in the AC64 stack, its performance showed a non-sensitive behavior to the selected variations with one type of GDL, while a different type showed larger scattering in results. The investigations between structure and stack performance are currently continued in WP5.

A digital case study was initiated to demonstrate the requirements of a fully automated defect inspection, converting and sorting module capable of feeding the PoP demonstrator. Different approaches of converting are under investigation, rotary stamping being prominent one.



WP4 "Cell Assembly PoP Development"

The Proof of Process Demonstrator equipment passed through the Acceptance Test at the equipment vendors site. To support the overall project schedule, the equipment was delivered directly to its final position at Intelligent Energy's site in December 2018 rather than performing dry cycling at WMG, the University of Warwick. Currently (May 19) the PoP Demo unit is undergoing dry running test and performance optimisation that will be completed around the final equipment Site

Acceptance Test at Intelligent Energy. Production of AC64 stacks for performance tests that feed into the MRL6 Validation activities are then planned through the remainder of 2019. Proof of data connectivity, led by Intelligent Energy's, from the PoP Demo into IE's central production database has been established and validated.

Deliverable report D4.3 has been published, presenting the implemented Proof of Process development facility, PoP Demo unit implemented design, system and control architecture, digital engineering activities, Factory Acceptance Tests and details of further planned work to be reported within D4.4 "PoP Demonstrator Cycling Trials Report" and D4.5 "Production Relevant Environment Facility".

Other activities have included the creation of a PoP Demo visualisation using Virtual Engineering Tools (Visual Components and Blender) and the baseline Discrete Event Simulation model (Witness Horizon). The DES model will be populated with operational performance data from the PoP Demo operation and various layout scenarios modelled to achieve the project KPIs.

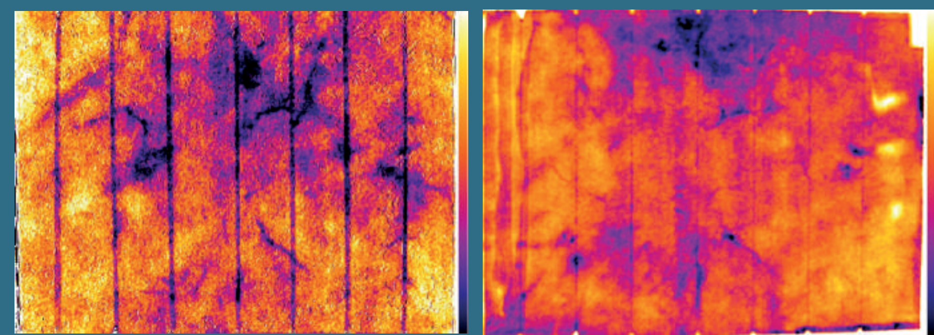
WP5 "Digital Materials Characterisation"

The GDL is a sensitive layer and as in any roll to roll production process, it is neither possible to prevent nor practical to remove all ensuing anomalies, some of which may be classified as defects, i.e. having a negative influence on performance. In evaluation of anomalies DIGIMAN's WP5 focuses on FPM GDL and its performance as benchmarked against IE's AC64 stack design. With the goal to track anomalies in the GDLs, and following a deep parameter study, alternative scanning techniques have been studied. Since thermal properties such as thermal diffusivity were found to vary in an unexpected manner, pulsed thermal thermography combined with thermal diffusivity analysis have been studied, and the resulting scans have been compared.

The analysys shows that the effective thermal diffusivity data for the LFA technique, which is widely considered as highly accurate (error<1%), are of the same order of the pulsed thermography data and corroborates with other thermal diffusivity analysys. It was also observed that the technique is very powerful and efficient in revealing subsurface heterogeneities. However, the MPL coated substrate obscures and therefore diminishes the resolution of the pre-coating anomalies.

In parallel to this, performance tests are on-going on AC64 and on differential cells to better understand the link between non-uniformities of GDL and performance. Preliminary results show that heterogeneities classified as 'defects' do not have the same influence when located on the anode and on the cathode sides and also as a function of the operating conditions.

Uncoated substrate with deliberately created heterogeneities



MPL coated substrate

WP6 "Digital manufacturing"

DIGIMAN aims, through the digital modelling of extrapolated "big data", via Industry 4.0 protocols, to determine the cause and effect relationships of the stack materials and stack assembly processes. For example, lineside scanning of GDLs will not only enable digital QC for known-good, ready to use components, but also aims to provide digitized maps of internal substrate structures. To supplement this I4.0 communications have been embedded within the PoP Demonstrator to facilitate the harvesting of process data, subsequently facilitating digital cause & effects – see scheme on the right.