Non-destructive quality control and testing tools

The role of TUC in Fit-4-AMandA project is the development of non-destructive quality control (NDT-QC) tools for the stack-assembly machine to increase yield and reliability of the produced fuel cell stack. Low throughputs together with high number of faulty produced stacks – every tenth stack is faulty and needs to be reworked – are among the main technical barriers in the fuel cell stack manufacturing. Additionally, fast quality-testing techniques are lacking. The goal of Fit-4-AMandA project is to elevate these constraints, and fast NDT-QC methods are necessary to do so.

There are three levels of NDT-QC: component level (e.g. half plates, GDL, PEM, catalyst, gaskets), sub-assembly level (e.g. MEA, BPP, single cell), and stack level. The following assumption has been made: if the stacking machine handles healthy units (components and sub-assemblies) and can keep the tolerances, the assembled stacks should perform according to the specification. To assure that healthy units are entering the stacking process, a 100-% inspection is necessary meaning every entering unit is tested not just a random selection. In addition, NDT-QC methods have to be fast enough or they create so-called bottlenecks, i.e. they limit the overall throughput of the manufacturing process.

The critical entries into the stacking process are bipolar plates (BPP) and membrane-electrode assemblies (MEA). After consulting the available literature as well as gathering the experience of the industrial partners (USK, PM and EWII), TUC has focused on the following tests:

- integrity and tightness tests of every BPP,
- tests of the MEA for defects typically occurring after hot-pressing,
- in-process and post-process quality control (QC) of sealings in the stack.

The method selection was optimised to minimise the measuring time allowing a stacking process to reach its maximum throughput. Among considered candidates are for example machine-vision systems and infrared (IR) thermography (see Figure 1)[1]. Potentially hazardous QC methods such as X-ray radiography were excluded.

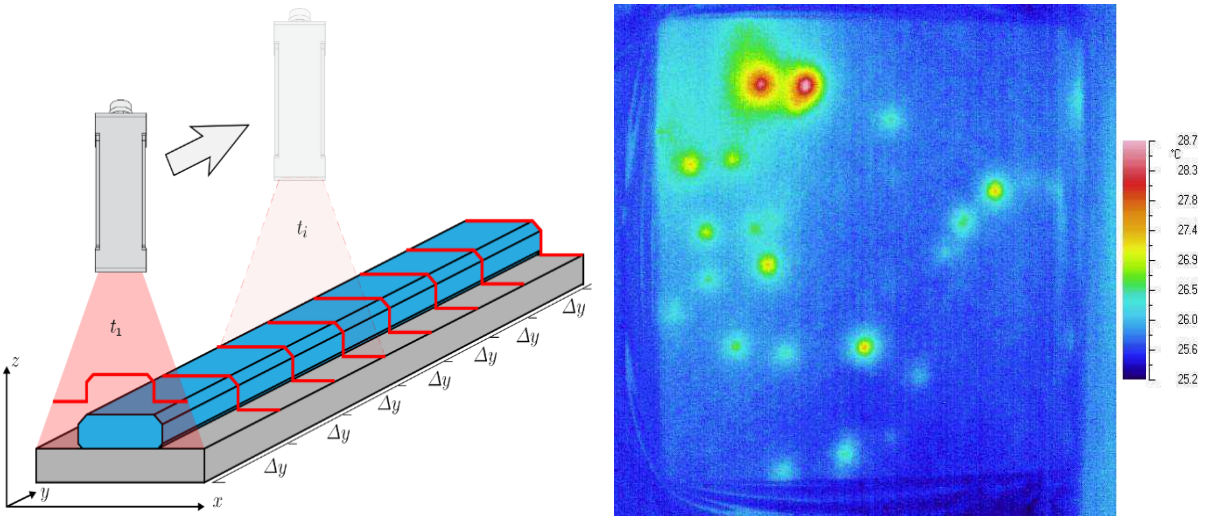

Figure 1: On the left, an illustration of the scanning process of a sealing; on the right, an IR thermograph of the hot-pressed MEA with GDL fibres protruding into the membrane.

[1] Picture on the left was made by TUC. Picture on the right was taken from Ulsh, M. et al.: Challenges to High-Volume Production of Fuel Cell Materials: Quality Control. ECS Transactions 50.2, 2013, pp. 919-926.

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