LOWCOST-IC
LOWCOSTINTERCONNECTS WITH HIGHLY IMPROVED CONTACT STRENGTH FOR SOC APPLICATIONS

PROJECT AND OBJECTIVES

The overall objective of LOWCOST-IC is to contribute to the successful upscaling of the widespread commercialisation of solid oxide cell (SOC) technologies by:

- increasing the robustness of the lifetime of SOC stacks by developing novel highly robust air electrode contact layers and testing new interconnect coatings in SOC stacks;
- minimising the interconnect development and production cost by introducing cheaper high-volume steel, applying state-of-the-art (SoA) large-scale roll-to-roll manufacturing methods for SOC manufacturing and developing a novel interconnect shape design process.

PROGRESS AND MAIN ACHIEVEMENTS

- Work package (WP) 2 aimed to reduce interconnect costs without affecting performance by exploring steel grades, coatings and manufacturing processes. The highlights are as follows:
  - roll-to-roll manufacturing – feasibility demonstrated, including shaping with hydroforming;
  - chromium evaporation – reduced by 30 times;
  - low-cost steels – comparable performance to specialised steel in terms of corrosion rate, chromium evaporation and area-specific resistance (ASR);
  - ASR of < 20 mΩcm$^2$ at 850 °C after 3,000 hours of operation achieved.

- In WP3, a new interconnect design with optimised flow distribution was developed, based on an efficient three-dimensional multiphysics model considering flow, heat transfer, mechanical stresses and electrochemical reactions.
  - In WP4, novel contact layers were developed by DTU, based on in situ reactive bonding, using metallic powders as precursors to form strong bonds through oxidation and reaction.
  - In WP5, four stack designs were produced using different materials to demonstrate developed materials. A stack with Sanergy 441 HT interconnector steel-coating solution was tested for 3,500 hours at 800–850 °C. Sanergy HT 441 with CeCo coating showed more ASR degradation than Crofer 22 APU with MCF coating but performed better at lower temperature. A stack with the new contact layers performed similarly to standard solutions without optimisation.

- In WP6, the technical improvements converted into monetary values showing that the mass manufacturing routes would be commercially competitive compared with in-house production because of the scalable processes of roll-to-roll and high-speed printing.

- In WP7, the work was disseminated through 12 published papers, with 4 more in preparation; 11 conference presentations; and 2 workshops, each with 32 participants comprising academics and most of the SOC stack manufacturers in Europe.

FUTURE STEPS AND PLANS

- Stack modelling will continue in national and EU projects, e.g. the AMON project.
- The material development for contact layers will be paused due to lack of funding.
- A recommendation will be made to Hydrogen Europe to put more effort back into material research.

QUANTITATIVE TARGETS AND STATUS

<table>
<thead>
<tr>
<th>Target source</th>
<th>Parameter</th>
<th>Unit</th>
<th>Target</th>
<th>Achieved to date by the project</th>
<th>Target achieved?</th>
<th>SoA result achieved to date (by others)</th>
<th>Year for reported SoA result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project's own objectives</td>
<td>Fracture energy of contact layer</td>
<td>J/m$^2$</td>
<td>5.1</td>
<td>19.6</td>
<td>✓</td>
<td>1.7</td>
<td>2013</td>
</tr>
<tr>
<td></td>
<td>ASR of contact layer at 750 °C</td>
<td>mΩcm$^2$</td>
<td>15</td>
<td>18</td>
<td>✓</td>
<td>15</td>
<td>2019</td>
</tr>
<tr>
<td></td>
<td>ASR of contact layer at 850 °C</td>
<td>mΩcm$^2$</td>
<td>25</td>
<td>15</td>
<td></td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>