Hydrogen from Regenerative Energy Power Sources: pressurized alkaline electrolyser with high efficiency and wide operating range ("RESelyser")

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The project RESelyser develops high pressure, highly efficient, low cost alkaline water electrolysers that can be integrated with renewable energy power sources (RES) using an advanced membrane concept, highly efficient electrodes and a new cell design. A new separator membrane with internal electrolyte circulation and an adapted design of the cell to improve mass transfer, especially gas evacuation is investigated and demonstrated. Intermittent and varying load operation with RES is addressed by improved electrode stability and a cell concept for increasing the gas purity of hydrogen and oxygen especially at part load operation. Also the system architecture is optimized for intermittent operation of the electrolyser.

It could be demonstrated that electrodes with a plasma sprayed coating layer give an overpotential reduction of 360 mV compared to uncoated electrodes thus showing high performance and stability. A double layer diaphragm with internal KOH supply is expected to improve the gas purity and high current density performance of the cell. The e-bypass separator concept of internal layer electrolyte supply could be realised and tested in a 300 cm^2 single cell electrolyser.

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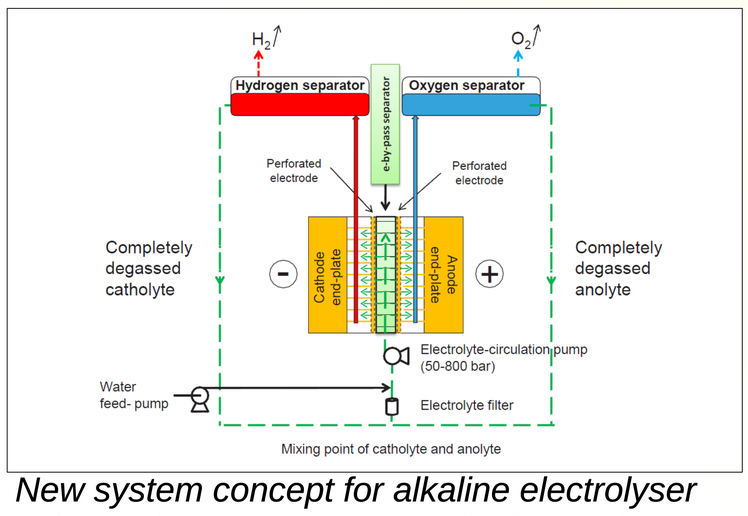
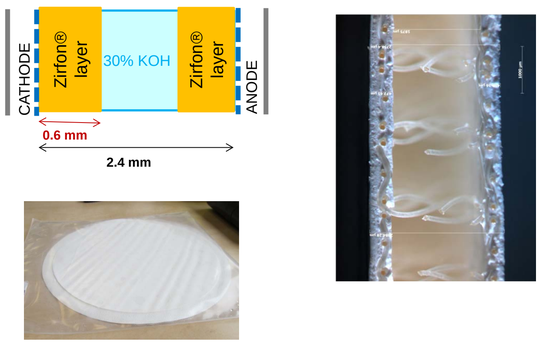
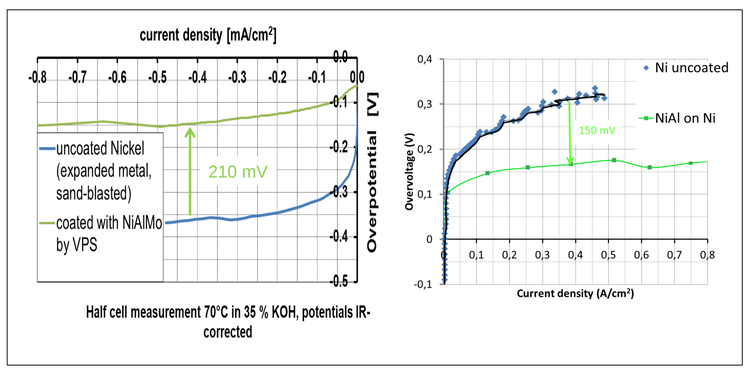


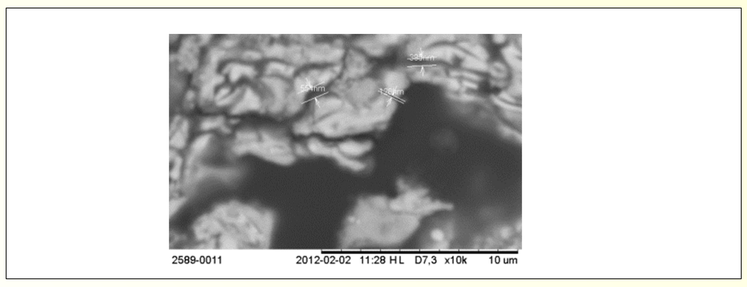
New system concept for alkaline electrolyser using "E-bypass separator" with internal electrolyte channel.
+ Less gas impurities at low current and high pressure
+ Better wetting of electrodes at high current



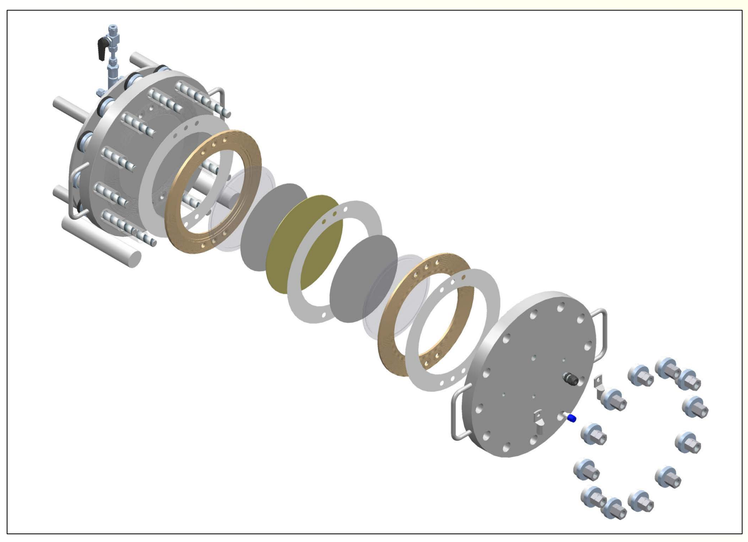
E-bypass separator with internal electrolyte channel: "E-bypass separator" diaphragms with internal electrolyte bypass and properties for maximum benefit of the cell were developed with a total thickness (including the internal electrolyte channel) between 1.4 and 3.4 mm at the size of a 300 cm^2 electrolyser.



Electrode coatings using Vacuum Plasma Spraying were demonstrated reducing the overpotential of a nickel electrode by 210 mV for the cathode and 150 mV for the anode thus increasing the efficiency. NiAlMo coating of cathode increases the stability during on-off-operation.



Pore size analysis of VPS-coated and activated NiAlMo electrode. 3D SEM measurements are planned to see the evolution of pore size distribution in long term electrolyser operation.



300 cm^2 single cell realising the e-bypass separator concept.

Test station with single cell integrated. Variation of flow in internal electrolyte channel is tested investigating the effect on gas impurities and current-voltage curve.

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