Evaluation of non-precious catalysts in acid-alkaline hybrid fuel cell

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Contact:
Dr. Prashant Khadke
Room: 15.08
Tel: +49 030 838 72383
Email: prashant.khadke(at)fu-berlin.de
ORCiD: https://orcid.org/0000-0001-7386-8378

Project Summary

Alkaline membrane fuel cell (AMFC) technology offers a significant cost advantage over proton exchange membrane fuel cell (PEMFC) technology, since less expensive materials such as transition metals/metal oxides can be used as catalysts. However, the current power output of AMFC is low, even with Pt

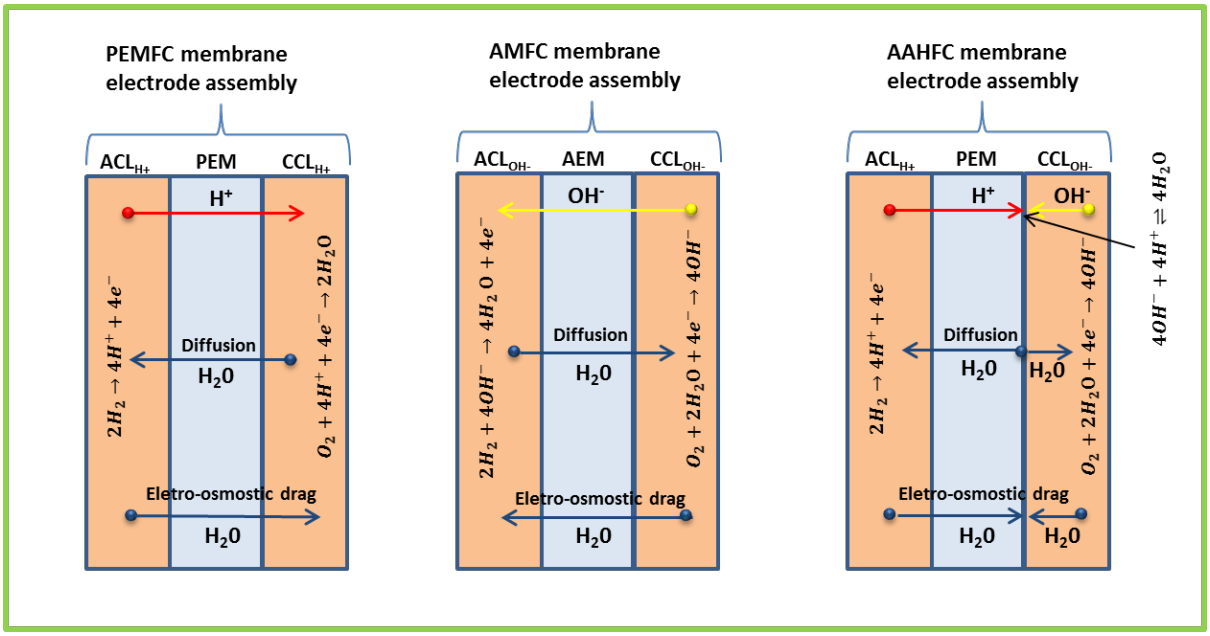

Fig. 1 Schematic of PEMFC, AMFC and AAHFC

catalysts, and it is presently not mature enough to compete with PEMFC technology. To overcome challenges faced by PEMFC and AMFC and simultaneously exploit the advantages of PEMFC and AMFC, acid alkaline hybrid fuel cell (AAHFC) is being developed. In this fuel cell, the anode catalyst layer (ACL) is made up of catalyst and cation exchange ionomer whereas cathode catalyst layer (CCL) is made up of catalyst and AEM. These two electrodes are assembled together with a proton exchange membrane (PEM) as shown in Fig. 1 where differences between the PEMFC, AMFC and AAHFC are depicted. AAHFC MEA eliminates anode flooding, uses an alkaline cathode, produces water close to the cathode, and uses a PEM, which is presently superior to AEM in terms of conductivity, durability and water permeability. With further optimization in the cell design, AAHFC has a high potential to replace PEMFC in the immediate future.

Cathode catalyst screening in AAHFC

In AAHFC the anodic reaction is expected to be very fast, anode flooding and early mass transfer limitation of water (as observed in AMFC) are eliminated. This allows to quickly screen various non-precious catalysts for ORR at conditions similar to AMFC. In addition, by comparing the activity of several catalysts in AAHFC and RDE set up, we aim to determine the generalized activity differences of catalysts at catalyst-ionomer interface and catalyst-liquid electrolyte interface.

Co-operation partners

Besides investigation of several in-house made catalyst samples for ORR, several nickel based catalysts developed (see Fig. 2) by the group of Prof. Wolfgang Ensinger (TU Darmstadt) are being evaluated at our group.

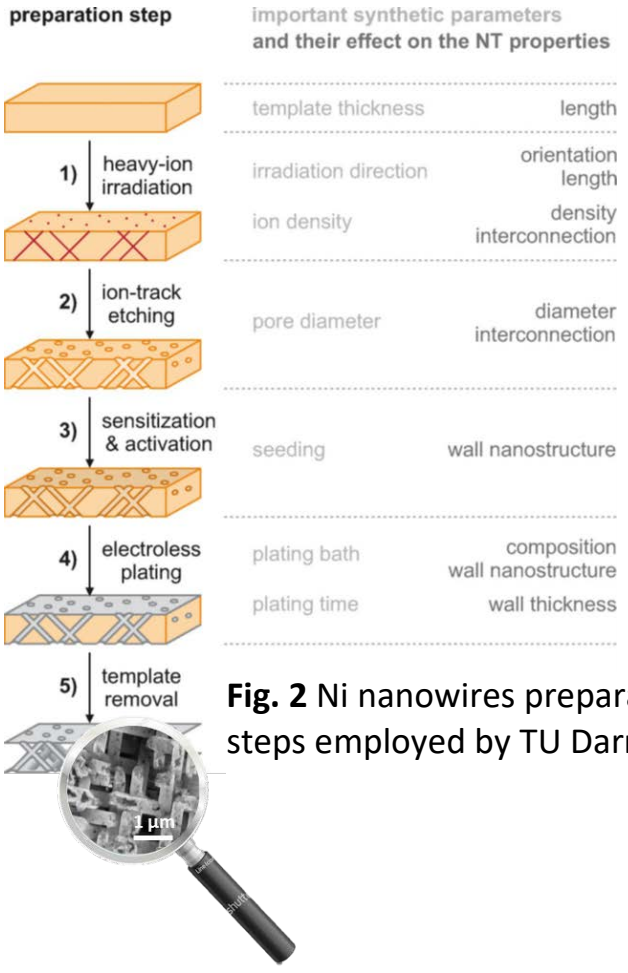

Fig. 2 Ni nanowires preparation steps employed by TU Darmstadt