# Scale-up of a Swiss-roll mixed-reactant fuel cell

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The conventional design of PEM fuel cell stacks is based on a plate-and-frame in series architecture that evolved from Volta's original concept of the zinc-air battery stack. The performance, durability and cost of the various PEM fuel cell stack components (membrane, electrodes, bipolar flow-field plates) in conjunction with the complex thermal and water management, are some of the major challenges hampering the larger scale adoption of this technology.

Recently, we introduced an innovative Swiss-roll architecture for mixed-reactant fuel cells (MRFCs) both in monopolar and bipolar mode. The Swiss-roll MRFC (SR-MRFC) addresses some of the above-mentioned challenges of fuel cell technology by eliminating the need for ion exchange membranes and bipolar flow-field plates, while providing a lighter, more compact, cylindrical stack architecture [1,2]. As shown in Fig. 1, in the Swiss-roll design, a flexible sandwich of electrodes and separators is rolled around an electronically conductive central axis to give a compact 3D electrode space for the fuel cell reactions. The Swiss-roll MRFC concept is applicable to a variety of alkaline or acid fuel cell systems.

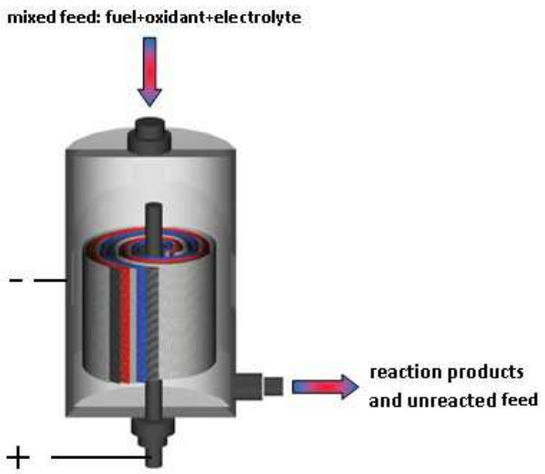


**Fig.1**: Conceptual view of a Swiss-roll MRFC

In our previous work satisfactory performance of the SR-MRFC was obtained for a direct borohydride fuel cell (DBFC) supplied with a two-phase mixture of aqueous 1 M $NaBH_4$/2 M NaOH and oxygen gas. There, a 20 $cm^2$ geometric surface area SR-MRFC with 2 layers of a hydrophilic microporous separator (Scimat® 720/20) and a Pt-$MnO_2$ anode-cathode pair was operated in monopolar single-cell mode at 323 K, 105 kPa(abs) to give a peak superficial power density of 640 $Wm^{-2}$ (64 $mWcm^{-2}$) [2].

To further exploit the Swiss-roll concept, the present work focuses on scale-up of the Swiss-roll reactor from 20 $cm^2$ to 100 $cm^2$ and 200 $cm^2$.

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## References

[1] C. W. Oloman, UK Patent GB2474202 (B), 2012.

[2] A. Aziznia, C.W. Oloman, E.L. Gyenge, "*A Swiss-roll liquid gas mixed-reactant fuel cell*", **Journal of Power Sources**, 212 (2012) 154–160.