# Molten Salt Electrolytes and Performance of Electrocatalytical Membrane Cells for Flue Gas Cleaning.

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Flue gas cleaning by use of electrocatalytic molten salt membrane cells might be attractive alternatives to the traditional wet scrubber desulfurization process ($deSO_X$) producing waste products and the denitrification by the SCR process ($deNO_X$) where the widely used $V_2O_5/TiO_2$ catalyst experiences rapid deactivation in potassium containing off gases from e.g. biomass or combined biomass/fossil fuel fired power plants.

The cell design[1] is shown as a principal sketch in Figure 1 for the $deSO_X$ process. The porous NiO electrodes are separated by a $V_2O_5/M_2S_2O_7$ (M = alkali) molten salt membrane supported on a YSZ membrane. The cell operates at 350-450 °C where the electrolyte is molten and the oxidation process $SO_2 + ½O_2 \rightleftarrows SO_3$ can take place catalyzed by the vanadium(V) oxosulfato complexes formed in the melt.[2] The electrode processes are $SO_3 + ½\ O_2 + 2\ e^- \rightleftarrows SO_4^{2-}$ where sulfate ions are formed at the cathodic flue gas side and the reverse process liberating $SO_3$ and $O_2$ takes place on the anodic product side. Here the final product could be sulfuric acid or oleum of commercial grade.

A similar cell design is under development for the $deNO_X$ process where the electrolyte is a $MNO_3$ (M = alkali) melt at 300-400 °C. At the anodic flue gas side NO is oxidized to $NO_2^-$ by the reaction $NO + ½O_2 \rightleftarrows NO_2^-$ and the reverse reaction liberating NO as a concentrated gas takes place at the cathodic product gas side. The final product could be nitric acid of commercial grade after catalytic oxidation of the product gas.

Our recent results concerning physico chemical properties of possible electrolyte candidates like the $M_2S_2O_7$-$MHSO_4$-$V_2O_5$ and $MNO_3$-$MNO_2$ (M = alkali) molten systems as well as the catalytic and electrochemical processes taking place during cell operation will be presented together with the latest results concerning the performance of the prototype cells prepared so far.

References:

1 D.J. McHenry and J. Winnick, Aiche J., 40 (1994) 143.

2 O.B. Lapina, B.S. Bal'zhinimaev, S. Boghosian, K.M. Eriksen, R. Fehrmann, Catal. Today, 51 (1999) 469.

Figure 1. Electrochemical cell for flue gas cleaning.