

THE INFLUENCE OF ELECTROCHEMICAL TREATMENT ON ELECTRODE REACTIONS FOR VANADIUM REDOX FLOW BATTERIES

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The motivation for this work was to obtain an overview of the electrochemical behaviour of vanadium reactions on electrochemically treated glassy carbon electrodes in order to be able to make reproducible statements about changes with the treatment. In addition, optimal conditions for the reactions should be found in order to create a basis for targeted pre-treatment of the electrodes and, if applicable, a possibility for in situ treatments. Furthermore, if possible, causes should be determined by the behavior.

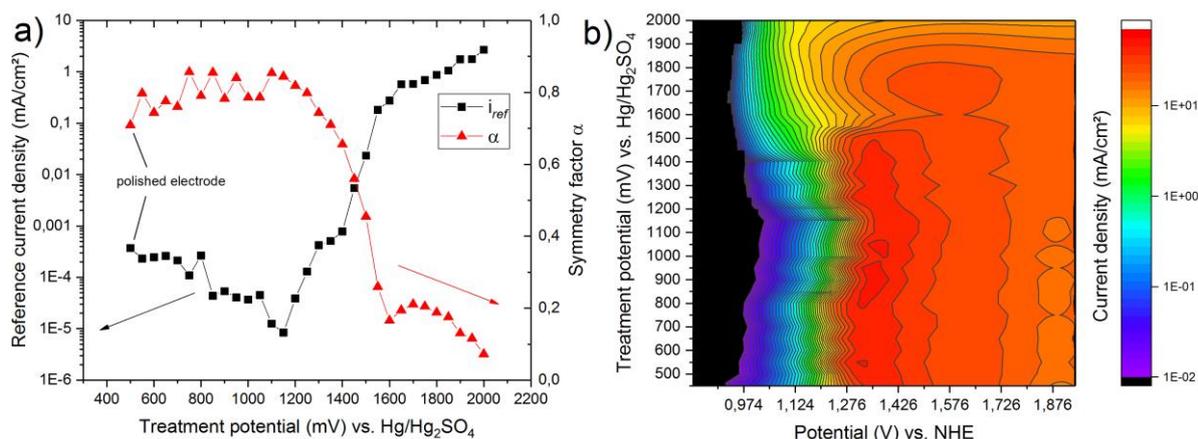


Figure 1: a) Reference current densities i_{ref} and symmetry factors α and b) linear sweep voltammograms for the oxidation of 0.1 M VO²⁺ at glassy carbon in 2 M H₂SO₄ at different electrode treatment potentials.

A glassy carbon electrode was first polished and then treated in 2 M H₂SO₄ at different potentials. In a separate measurement setup, linear sweep voltammograms were then recorded instead of cyclic voltammograms in order to change the electrode as little as possible and to calculate kinetic values from the obtained data. In addition, roughness values were determined at selected treatment potentials using confocal microscopy and the surface composition was analyzed using XPS.

The reaction rates increased significantly in all reactions compared to polished electrodes and had an optimum treatment potential of approx. 1600 mV vs. Hg/Hg₂SO₄, although the oxidation reaction of V²⁺ and the reduction reactions of V³⁺ and VO₂⁺ had opposite tendencies to oxidation of VO₂⁺ and the reduction of VO₂⁺ in the area of low treatment potentials. In the former, the kinetics increased and in the latter, they decreased.

No correlation was found to the roughness or size of the stretched surfaces, although these changed significantly as a result of the treatment. XPS measurements gave indications of a dependence on oxygen functional groups for the different reactions.