

Preliminary note

OXYGEN EVOLUTION ON LaCoO_3 -TYPE ELECTRODES

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One of the key problems in water electrolysis of importance for a future hydrogen economy is formed by the oxygen electrode. Therefore there is a search for cheap electrode materials, which show favourable electrochemical kinetics and which are chemically and physically stable. Since we had ample experience with LaCoO_3 -type electrodes under cathodic conditions [1] we decided to study the anodic behaviour of these materials in alkaline solutions. In order to look at the influence of substituting the lanthanum ion the following compounds were chosen: $\text{La}_{0.80}\text{Ba}_{0.20}\text{CoO}_{3-y}$, $\text{La}_{0.50}\text{Ba}_{0.50}\text{CoO}_{3-y}$, $\text{La}_{0.70}\text{Sr}_{0.30}\text{CoO}_{3-y}$, and $\text{La}_{0.30}\text{Sr}_{0.70}\text{CoO}_{3-y}$.

These materials were prepared from La_2O_3 , Ba- or SrCO_3 and CoCO_3 or -acetate according to refs. 2 and 3. Pellets were pressed at $(1-4) \times 10^8$ Pa and sintered in air at 1100–1200°C. These pellets were provided with contacts by means of a painted gold layer or a silver epoxy layer. Rotating Disk Electrodes (RDE) or vertical stationary electrodes were made by molding the pellets in Technovit two-component resin. The electrode surfaces were polished, followed by ultrasonic cleaning. Experiments were performed at room temperature in a three-compartment cell filled with 6 M KOH. Anodic polarisations were applied potentiostatically.

The results of the measurements are presented in Fig. 1. Potentials, which are corrected for ohmic drops ($R_\Omega = 2.5-10 \Omega$), are stated with respect to a Reversible Hydrogen Electrode (RHE) in the same solution whereas the current densities are based on the apparent geometrical surface areas. Tafel slopes and apparent exchange current densities have been collected in Table 1.

The long-term stability of two electrodes was investigated by occasionally recording the current at 1.445 V vs. RHE in the same solution. The electrodes

TABLE 1

Kinetic parameters for O_2 evolution on various LaCoO_3 -type electrodes

	Tafel slope/ mV decade ⁻¹	Apparent exchange current density/A m ⁻²
$\text{La}_{0.80}\text{Ba}_{0.20}\text{CoO}_{3-y}$	57	4.8×10^{-4}
$\text{La}_{0.50}\text{Ba}_{0.50}\text{CoO}_{3-y}$	59	2.6×10^{-3}
$\text{La}_{0.70}\text{Sr}_{0.30}\text{CoO}_{3-y}$	59	1.1×10^{-4}
$\text{La}_{0.30}\text{Sr}_{0.70}\text{CoO}_{3-y}$	74	2.3×10^{-3}

were repolished after 50 days ($\text{La}_{0.50}\text{Ba}_{0.50}\text{CoO}_{3-y}$) and 75 days ($\text{La}_{0.80}\text{Ba}_{0.20}\text{CoO}_{3-y}$). The results are presented in Figs. 2 and 3. After the experiments microscopical examination of the surfaces of the electrodes revealed considerable surface roughening under anodic conditions. This surface roughening can explain the behaviour of the current with respect to time and polishing. Analysis of the used electrolyte by Emission Spectrography showed the absence of constituent

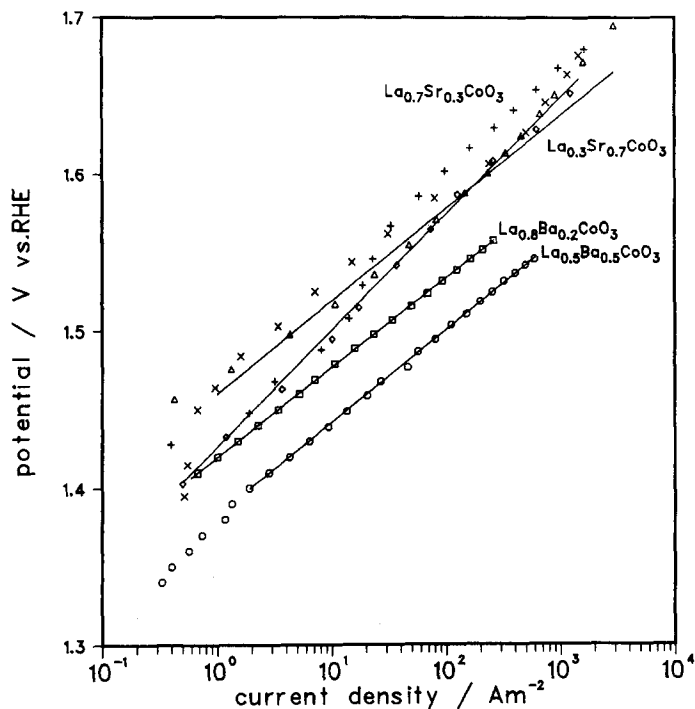


Fig. 1. Tafel plots measured in 6 M KOH at room temperature; IR corrected. (\square) $\text{La}_{0.80}\text{Ba}_{0.20}\text{CoO}_{3-y}$, i.p.; (\circ) $\text{La}_{0.50}\text{Ba}_{0.50}\text{CoO}_{3-y}$, i.p.; (Δ) $\text{La}_{0.70}\text{Sr}_{0.30}\text{CoO}_{3-y}$, i.p.; (+) $\text{La}_{0.70}\text{Sr}_{0.30}\text{CoO}_{3-y}$, d.p.; (\times) $\text{La}_{0.30}\text{Sr}_{0.70}\text{CoO}_{3-y}$, i.p.; (\diamond) $\text{La}_{0.30}\text{Sr}_{0.70}\text{CoO}_{3-y}$, d.p. (i.p., increasing potential; d.p., decreasing potential)

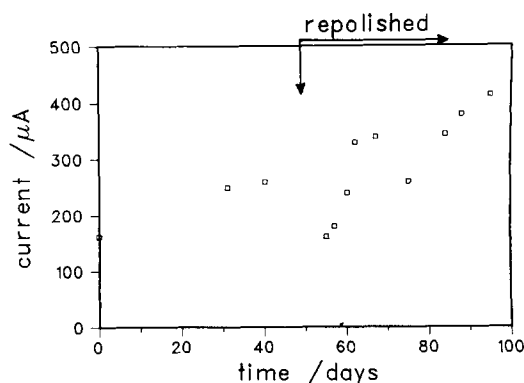


Fig. 2. Current at 1.445 V vs. RHE for the $\text{La}_{0.50}\text{Ba}_{0.50}\text{CoO}_{3-y}$ electrode.

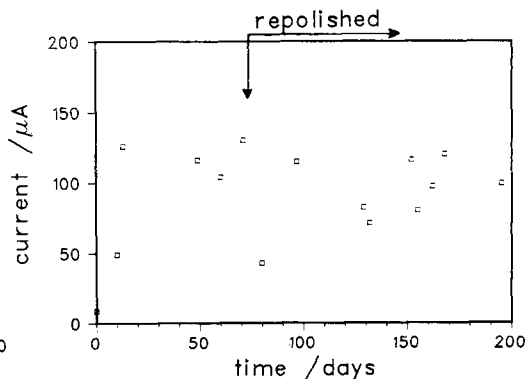


Fig. 3. Current at 1.445 V vs. RHE for the $\text{La}_{0.80}\text{Ba}_{0.20}\text{CoO}_{3-y}$ electrode.

elements of the electrode materials. So it may be concluded that the surface roughening is not a chemical process but a physical one.

Since the materials discussed above meet for the greater part the demands mentioned at the beginning of this note they deserve further study.

REFERENCES

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