Use of Metal Sulfides as Anode Catalysts in H_2S SOFC

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H_2S often appears in petroleum and natural gas. The concentration of H_2S present in natural gas ranges from trace amounts to more than 80%. Disposal and treatment of H_2S is regarded as a worldwide problem. Typically, gas processing plants convert this toxic gas into elemental sulfur and water vapor via the well-established Claus process. The reaction is highly exothermic. Part of the energy can be recovered as low-grade energy in the steam produced. However, it is much more desirable to recover this energy as electricity in a highly efficient manner.

The feasibility for electrochemically oxidizing H_2S in a fuel cell was first demonstrated in the late 1980s [1]. More efforts have been spent to investigate alternative electrolytes and anode electrocatalysts in H_2S SOFC [2-6]. Previously, we reported that Pt has good catalytic activity, but degrades over time in H_2S stream [6]. Since H_2S is extremely corrosive to most metals and metal oxides at high temperatures, we have examined several kinds of metal sulfides as anode catalysts in H_2S-O_2 fuel cells. Compared with expensive precious metals like Pt, metal sulfides are cheaper. Some of them, such as MoS_2, are often used as catalysts in variety of hydrogenation/dehydrogenation and hydrodesulfurisation reactions in the petroleum industry. In the present work, we have shown that MoS_2 possesses a good electronic conductivity as well as better catalytic activity than Pt.

Fig. 1 and Fig. 2 compare the performances of the H_2S-O_2 SOFC at 800°C using two different anode materilas: MoS_2 and Pt. The cathode material is Pt. Pure H_2S is used as fuel gas and air is supplied as oxidant. Although the maximum current densities for both anodes are almost the same, around 100 mA/cm^2, the maximum power density obtained is 24.9 mW/cm^2 for MoS_2 and 15.4 mW/cm^2 for Pt. In the low current region, cell-potential losses for Pt are higher, which indicates that Pt is less active than MoS_2. Some factors that affect the long-term stability of the cell performance for MoS_2 as anode will be discussed.

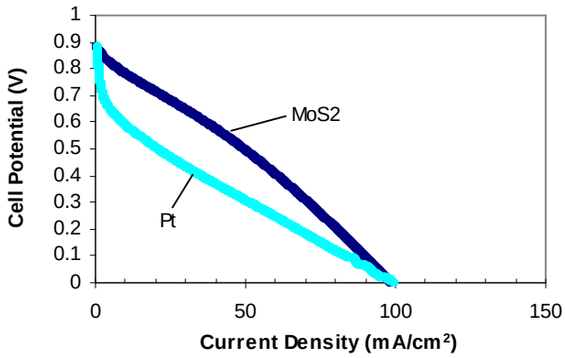

Fig. 1 I-V characteristics of H_2S-O_2 fuel cell using MoS_2 and Pt as anodes at 800°C

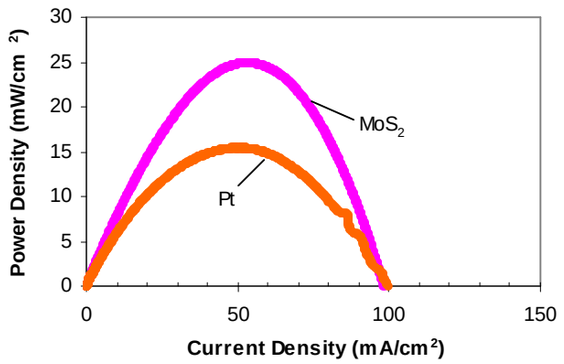

Fig. 2 Current *vs.* Power curve for H_2S-O_2 fuel cell using MoS_2 and Pt as anodes at 800°C

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