Biomass-derived fuel, e.g., biogas, is a potential fuel for solid oxide fuel cells (SOFCs). At operating temperature (850 °C) reforming of the carbon-containing biogas takes place over the Ni-containing anode. However, impurities in the biogas, e.g., H2S, can poison both the reforming and the electrochemical activity of the anode. Tests of single anode-supported planar SOFCs were carried out in the presence of H2S under current load at 850 °C. The cell voltage dropped as we periodically added 2–100 ppm H2S to an H2-containing fuel in 24 h intervals, but it regenerated to the initial value after we turned off the H2S. Evaluation of the changes of the cell voltage suggests that saturation coverage was reached at approximately 40 ppm H2S. A front-like movement of S-poisoning over the anode was seen by monitoring the in-plane voltage in the anode. Furthermore, impedance spectra showed that mainly the polarization resistance increased when adding H2S. These changes in resistance were found to happen at 1212 Hz, which is related to reactions at the anode–electrolyte interface. These findings can be used to identify S-related effects on the performance, when an SOFC is fuelled with biogas or other fuels with H2S impurities and thus help in the development of more sulfur tolerant SOFCs.