Fuel cells are a popular power source, however, plagued by the problem of water management. To further investigate the performance of Nafion-like membranes in relation to water management, a novel system for humidity chamber electrochemical spectroscopy has been constructed and tested. The system allows for measurement of proton exchange membrane conductivity under well defined conditions, allowing for more insight into the behaviour of the membrane. Measurements of etched membranes have been performed, showing degradation of gold plated copper alloy electrodes caused by the etched membrane's surface. This behaviour has been hypothesised to arise from formation of radicals due to the etching.