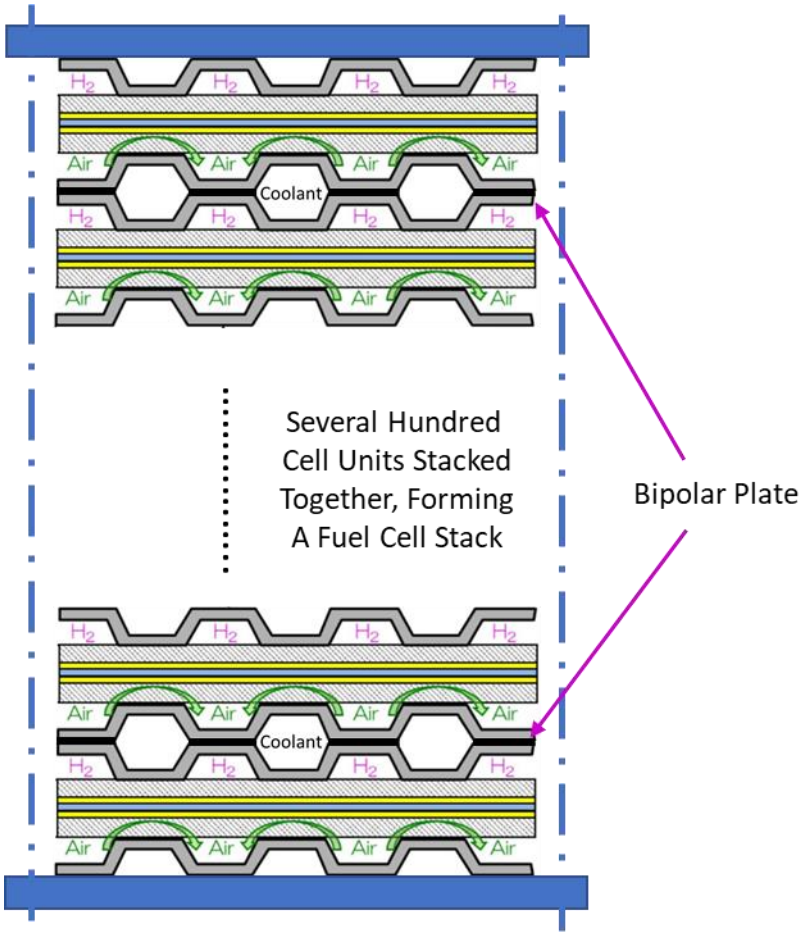
Project Description

Development of Niobium-based Bipolar Plates for PEM Fuel Cells



Proton exchange membrane (PEM) fuel cell technology has reached the early stage of commercial applications, becoming an integral part of strategies for global climate change mitigation and post-pandemic economic recovery. Bipolar plates, as illustrated in the schematic below, are key components in PEM fuel cell stacks, and they fulfill important functions and requirements to allow fuel cell stacks to achieve high power density, high efficiency, low cost and long lifetime in practical applications. However, current bipolar plates contribute up to 80% by weight and volume and 50% by cost of PEM fuel cell stacks, hence a key component for the reduction of fuel cell stack weight, volume and cost – this is instrumental for automotive and even more important for aerospace applications. Because of corrosive and reactive environment of fuel cells, few materials can survive with enough lifetime. Conventional bipolar plates use graphite (or carbon) based plates that are too heavy and bulky with weak mechanical strength, coated stainless steel plates that do not have sufficient lifetime and have a low thermal and electrical conductivity. This project aims to develop

- bipolar plates using niobium-based materials which have excellent thermal and electrical conductivity, corrosion resistance and mechanical strength; and/or
- metallic bipolar plates with niobium-based coating films for excellent performance and durability.

The project involves the design, manufacturing, testing and characterization, both ex-situ and in-situ of fuel cell assemblies, with theoretical analysis, numerical modeling/simulation, and experimental measurements. Two Postdocs and ten PhD students will work full time on this project under the supervision of Professor Xianguo Li and Professor Samaneh Shahgaldi.