Dry reforming of methane (DRM) is an important chemical reaction in developing a carbon-based economy as it utilizes two greenhouse gases, namely CH4 and CO2, to form syngas (CO:H2 ratio of 2), which is suitable for manufacturing higher hydrocarbons through the well-known Fischer-Tropsch synthesis process. Ni-based catalyst materials are an excellent candidate for performing the DRM process, owing to their low cost and high catalytic activity. However, due to the extreme temperature, and pressure conditions required for the operation, Ni catalysts suffer with severe deactivation by coke deposition and offers poor poison resistance compared to noble metal catalysts.

To develop coke-resistant catalysts, Ni-based carbides and nitrides will be explored for DRM. Previous studies indicate that the metal carbides exhibit Pt-like behavior and furthermore they are claimed to exhibit higher poison-resistant compared to noble metals [1]. To gain deeper insights into the deactivation mechanism, coke deposition was studied in real-time using operando spectroscopic tools like UV-Vis and Raman spectroscopy. Additionally, the reaction is performed under steady-state and unsteady state conditions to understand the coking mechanism. The coking behavior over different catalytic materials was evaluated using DFT. The information from these studies will be used as a guide in the rational design of catalytic materials for DRM.