



PROJECT FACTS

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CLEAN FUELS & CHEMICALS

Fuels Cell Vehicles

Hydrogen powered fuel cell vehicles (FCVs) have zero emissions, high energy efficiency compared to combustion engines, and potential for independence from foreign oil imports. Fuel cell vehicles operate on hydrogen as a fuel which can either be stored in hydrogen tanks or produced on-board using a reformer. The membrane-electrode-assembly (MEA) is one of the key components of a fuel cell stack which consists of an anode and a cathode electrode separated by a proton conducting membrane (nafion resin). The anode and cathode electrodes are catalysts comprising of 40-50 wt% platinum metal which increases the cost of a fuel cell exponentially. To realize the dream of mass production of fuel cell vehicles, the cost of fuel cell stack needs to be driven down by increasing the Pt catalyst efficiency and reducing the amount of Pt used in fuel cells. The target projected fuel cell cost to mass produce FCVs is a quarter of the current cost which can only be achieved by a break-through in the fuel cell technology.

At CAER, we are collaborating with Toyota Motor Corporation to design a new proprietary catalyst system based on ultrafine (1-2 nm) Pt nanoparticles which are uniformly dispersed and supported on carbon support in the nafion ion resin matrix. The ultrafine catalyst particles increase the effective surface area of the platinum metal thus increasing the overall efficiency. The conventional catalyst contains Pt nanoparticles of size 3-10nm which results in significant precious metal loss. Based on the preliminary results, this new electrode design process would require much less Pt metal compared to the conventional electrode manufacturing process. We at CAER are pioneering the actual chemistry and design of the catalyst electrodes by studying the catalyst layers using high resolution electron microscopy (HR-TEM, HR-STEM, EELS and 3D-Tomography). The electrodes are tested in actual fuel cells at Toyota Motor Corporation headquarters in Japan. The successful implementation of the new process would realize the fuel cell vehicle dream much closer than the targeted year of 2017 by most auto manufacturers.