IN-SITU SYNTHESIS OF FexPy NANOPARTICLES

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Iron phosphide is an earth abundant semiconductor with several applications, such as an electrocatalyst for the hydrogen evolution reaction (HER) and the oxygen evolution reaction (OER). Water-splitting as a way of producing hydrogen gas is essential to explore due to its low carbon footprint, and using earth abundant catalysts such as iron phosphide is preferred due to being inexpensive, active, and electrochemically stable. Therefore, it is of interest to explore methods to manufacture iron phosphide and aim to achieve perfect crystallinity in combination with tuning the different crystalline phases, since they exhibit different catalytic activity. In this project we performed in-situ studies of the transformation of iron nanoparticles to iron phosphide nanostructures using an Environmental Transmission Electron Microscope (ETEM) interfaced with a Metal Organic Chemical Vapor Deposition (MOCVD) system. By tuning gas flows and temperature and directly seeing the impact of these parameter changes, several different phases of iron phosphide have been created, such as Fe_2P and FeP and the transformation between phases has been observed. The phases involved in the experiments were characterized via energy dispersive X-ray (EDX) spectroscopy and FFT spectra obtained from the high-resolution TEM (HRTEM) images. Our future work will aim towards studying the transformation to iron phosphide further, exploring and characterizing the possible phases and achieving selection of crystal structure in a controlled manner.