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Since methane is the main constituent of natural gas and biogas, it is important to develop a more cost-effective, efficient method of transporting methane for fuel using intermediate chemicals. One major obstacle in industrial chemical processes has been converting methane gas into liquid methanol. Methane activation by heterogeneous catalysis will play a key role to secure the supply of energy and chemical fuel in the future. We report the synthesis of bismuth vanadate nanocrystals for the photochemical oxidation of methane. Accordingly, we varied reaction conditions such as temperature, reaction time, pH, surfactants, and methodology in order to regulate the growth and structure of their surface crystalline facets. We used electron microscopy, X-ray diffraction, and absorption spectroscopy to characterize the structure and properties of the reaction products. We developed a system for gas chromatography in order to characterize the selectivity and activity of the nanocrystals for methanol production.

The preliminary results we obtained included bismuth vanadate nanocrystals of various morphologies: thick and thin platelets, nanorods, and bipyramids. Based on the results, the bipyramidal nanocrystals appear to be most effective for methane conversion. We will continue to alter and refine the procedures to better control their morphology and learn more about the corresponding photocatalytic properties using absorption spectroscopy, density functional theory, and etching.