Environmental Research, Technology Demonstration and Conference Project

ECF Project:	ECF 2017-49
Project Title:	Direct solar conversion of CO_2 to hydrocarbon fuels: Development and application of earth-abundant CuOx/Fe,Cu-doped Ni(oxy)hydroxide/TiO_2 photocatalysts
Principal Investigator:	Dr FENG Shien-Ping Tony, Department of Mechanical Engineering, The University of Hong Kong
Total Approved Grant:	$1,636,000
Duration:	1/12/2017 to 30/11/2019
Project Status/Remarks:	Completed
Project Scope:	This project aims to fabricate, characterise, and test a novel and operationally stable photocatalyst for direct solar conversion of CO_2 to hydrocarbon fuels, without requiring the use of relatively scarce/expensive noble metal catalysts such as platinum. The project objectives include – (a). Photocatalyst synthesis – the project will develop Cu/CuO/CuO_2 nanobelts sensitised with Fe,Cu-doped Ni-(oxy) hydroxide and bandgap engineering of TiO_2 with or without dopants such as carbon and nitrogen for CO_2 conversion to fuel; (b). Control of output reactants – the project will investigate hydrophobic/philic nature of Ni-(oxy) hydroxide co-catalyst to enable preferential control of the adsorbed species on its surface; (c). Optimisation of photocatalyst stability – the project will investigate the hypothesis that the surface wettability switching allow adsorbates on the surface to be "washed" and its relationship to the enhancement of the stability; and (d). Photocatalytic membranes – the project will fabricate photocatalyst upon a fine-mesh copper screen substrate to enable flow-through photocatalytic operation, achieving its mechanical robustness, high surface area, and the directionality of hydrocarbons exit to reduce back reaction, thereby enhancing the photoconversion rate.
Summary of the Findings/Outcomes:	The project team succeeded in synthesising various kinds of photocatalysts and the fabrication of photocatalytic systems. In addition, the project team successfully characterised and fabricated photocatalytic materials, and obtained positive results to understand the photocatalytic system in material, optical and electrochemical aspects for the control of output reactant. The demonstration of flow-through system for photocatalytic membrane application was also completed. The optimisation of photocatalyst stability via the surface wettability switching has also been demonstrated. All planned deliverables have been achieved in this project.