

Completion Report (MCEF21104)

Marine Conservation Enhancement Fund

Project Title: Development of CO₂-Reduction Catalysts to Alleviate Ocean Warming and Acidification

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1. Completion Report

1.1 Executive Summary

Hong Kong's marine ecosystems are increasingly threatened by two interconnected global environmental crises: ocean acidification and ocean warming. Both phenomena are driven primarily by rising atmospheric carbon dioxide (CO₂) concentrations resulting from anthropogenic emissions—industrial activity, transportation, and energy generation. As CO₂ is absorbed by seawater, chemical reactions produce carbonic acid, lowering ocean pH and disrupting the ability of marine organisms (corals, shellfish, plankton) to form calcium carbonate shells and skeletons. Concurrently, ocean warming stresses these same organisms, leading to coral bleaching, habitat loss, and declining biodiversity. These impacts cascade through the marine food web, ultimately threatening Hong Kong's fisheries, coastal protection and tourism, while also posing broader risk to food security and public health.

Addressing the root cause—excess atmospheric CO₂—requires not only emissions reduction but also the development of carbon utilization technologies that convert CO₂ from a waste product into a valuable resource. Photocatalytic CO₂ reduction offers a particularly attractive solution: using abundant solar energy to drive the conversion of CO₂ and water into useful chemical fuels and feedstocks, including carbon monoxide (CO), formic acid (HCOOH), methanol (CH₃OH), ethanol (C₂H₅OH), methane (CH₄), and ethylene (C₂H₄). Methane, for example, can potentially replace fossil natural gas, addressing both climate and energy security concerns simultaneously.