

Title: Sustainability of the Catalytic Activity of a Silica-Titania Composite (STC) for Long-Term Indoor Air Quality Control.

Authors: Janelle L. Coutts<sup>1</sup>, Lanfang H. Levine<sup>2</sup>, Jeffrey T. Richards<sup>3</sup>

Abstract:

TiO<sub>2</sub>-assisted photocatalytic oxidation (PCO) is an emerging technology for indoor air quality control and is also being evaluated as an alternative trace contaminant control technology for crew habitats in space exploration. Though there exists a vast range of literature on the development of photocatalysts and associated reactor systems, including catalyst performance and performance-influencing factors, the critical question of whether photocatalysts can sustain their initial catalytic activity over an extended period of operation has not been adequately addressed. For a catalyst to effectively serve as an air quality control product, it must be rugged enough to withstand exposure to a multitude of low concentration volatile organic compounds (VOCs) over long periods of time with minimal loss of activity. The objective of this study was to determine the functional lifetime of a promising photocatalyst – the silica-titania composite (STC) from Sol Gel Solutions, LLC in a real-world scenario. A bench-scale STC-packed annular reactor under continuous irradiation by a UV-A fluorescent black-light blue lamp ( $\lambda_{\text{max}} = 365 \text{ nm}$ ) was exposed to laboratory air continuously at an apparent contact time of 0.27 s and challenged with a known concentration of ethanol periodically to assess any changes in catalytic activity. Laboratory air was also episodically spiked with halocarbons (e.g., octafluoropropane), organosulfur compounds (e.g., sulfur hexafluoride), and organosilicons (e.g., siloxanes) to simulate accidental releases or leaks of such VOCs. Total organic carbon (TOC) loading and contaminant profiles of the laboratory air were also monitored. Changes in STC photocatalytic performance were evaluated using the ethanol mineralization rate, mineralization efficiency, and oxidation intermediate (acetaldehyde) formation. Results provide insights to any potential catalyst poisoning by trace halocarbons and organosulfur compounds.

<sup>1</sup> Scientist I, Craig Technologies (a teammate of ESC-Team QNA) and graduate student in the Department of Chemistry, University of Central Florida, Orlando, FL32816

<sup>2</sup> Senior Research Chemist, Enterprise Advisory Services, Inc. (a teammate of ESC-Team QNA), Mail Code: ESC-24, Kennedy Space Center, FL 32899 and AIAA senior member

<sup>3</sup> Research Chemist, Stinger Ghaffarian Technologies (a teammate of ESC-Team QNA), Mail Code: ESC-24, Kennedy Space Center, FL 32899