A new versatile *operando* photocatalytic cell for quick-EXAFS: the example of CO_2 photoreduction

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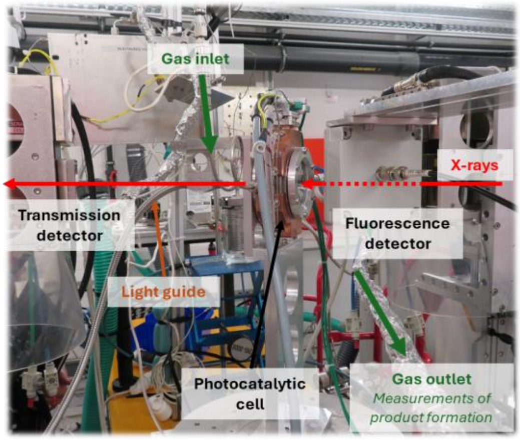
ABSTRACT

Over the past decade, photocatalysis has emerged as promising process for numerous applications including pollutant removal, water splitting or CO_2 conversion, through the harnessing of solar energy. However, achieving sufficient efficiency for industrial applications requires addressing several challenges. Most of these challenges relate to the design of the photocatalyst itself including light penetration and absorption, charges recombination, selectivity of the product formation, nature of active sites and photocatalyst deactivation[1]. *Operando* quick-EXAFS measurements is a powerful technique to unravel the structure-activity of the photocatalyst and to address these challenges by monitoring the electronic structure and local environment of a photocatalyst under working conditions.



In this work[2], we describe a versatile *operando* cell suitable for monitoring gas-phase photocatalytic reaction by quick-EXAFS in transmission or fluorescence in the energy range covered by the ROCK beamline[3], along with an in-line analysis of product formation by analytical methods such as mass spectrometry or gas chromatography. This development was carried out in the framework of the French 'PEPR LUMA'[4].

The capabilities of the *operando* cell will be demonstrated by studying Mo oxysulfides supported on TiO_2 used for the CO_2 photoreduction. After validating the cell by comparing the performances obtained at ROCK with that of a well-tested lab-cell, the behavior of these catalysts will be monitored by XAS at the Mo K-edge, using a Xe lamp (250-650 nm) as UV-visible source. To overcome the volume sensitivity of XAS for studying photocatalytic reactions (occurring at the sample surface where light interacts with the adsorbed species), a modulation-excitation[5] XAS was implemented. This technique has proven relevant and powerful to highlight the contribution of active species compared to silent spectator species during the photocatalytic process.

REFERENCES

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