CBC SEMINAR ANNOUNCEMENT

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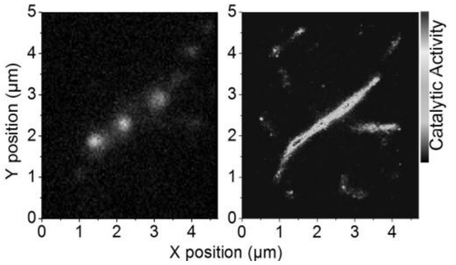
Fluorescence Microscopy: A Unique Tool in Catalysis Research

Light microscopy is a recent addition to the toolbox for *in situ* study of solid catalytic materials. It combines ease of use with non-invasiveness, high sensitivity and temporal resolution.[1,2] However, due to the diffraction of light, an optical microscope has a limited spatial resolution, which is insufficient to distinguish the nano-sized domains in catalytic solids. Here we show how single catalytic turnovers yield diffraction unlimited images of working inorganic catalysts. NASCA microscopy is experimentally simple, and yields super-resolution images of catalysts.
As a first case study, we investigated the Ti-MCM-41 catalyzed epoxidation of a phenylbutadienyl-substituted Bodipy probe using 35 mM tert-butylhydroperoxide.[3] The fluorescence microscope allows the selective detection of single, yellow fluorescent epoxidized Bodipy reaction products even against the overwhelming red, reagent fluorescence. A real-time movie containing multiple single epoxidation reaction events was recorded and the nanometer-accurate fitted positions of these individual events are plotted on the optical transmission image. These images clearly show that the catalytic reaction mainly occurs at the outer rim of the Ti-MCM-41 particles.
In a second case study, we extended this single turnover localization technique to acid zeolite catalysed reactions.[4] Whereas single turnover studies so far have been using large polycyclic substrates which cannot enter the zeolite micropores,[1,5] this study critically depends on identifying a small reagent that is converted into a single molecule detectable fluorescent product. Surprisingly furfuryl alcohol is such a reagent (Figure *left*). Similarly, from these single turnover fluorescence movies a nanoscale activity map can be generated (Figure *right*) which allow direct identification of nanometer-scale catalytic hotspots.
In this contribution we show that fluorescence microscopy allows the *in situ* observation of single catalytic turnovers for different types of nanoporous catalysts. This high-resolution single turnover mapping allows the direct localization of catalytic hotspots at the nanometer-scale, furthermore this approach it is an excellent tool for observing the complex interplay between diffusion and reaction at the single particle level.

REFERENCES

[1]M. B. J. Roeffaers, et al., Nature 2006, 439, 572. [2] G De Cremer et al., Chem. Soc.Rev. 2010, 39: 4703 [3]G. De Cremer, et al., Angew. Chem. 2010, 49, 908. [4]M. B. J. Roeffaers, et al., Angew. Chem. 2009, 48, 9285. [5]V. M. Martinez, et al., J. Am. Chem. Soc. 2008, 130, 13192.



Date:	**4th April 2012 (Wednesday)**
Time:	**2:30pm – 3:30pm**
Venue:	**NTU SPMS CBC Building Level 2, Conference Room**
Host:	**Asst Professor Edwin Yeow**