ΕΙΧΗΜΥΘ-ΙΤΕ

ΣΕΜΙΝΑΡΙΟ

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ΘΕΜΑ: Manipulating the Photoreactivity of Titanium Dioxide:
Insights from Scanning Probe Microscopy

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ΠΕΡΙΛΗΨΗ

Scanning probe microscopy and in particular Atomic Force Microscopy (AFM) provides the opportunity to study the morphology of actual catalytic particles, with nanometer-scale resolution of surface features. This work demonstrates the ability of AFM to probe directly both the metal photodeposition reactions and surface structures of metal-decorated titanium dioxide particles.
These materials are used as photocatalysts in environmental applications; metal-doped Tio2 particles exhibit enhanced activity for the oxidation of organic pollutants. Furthermore certain metal/Tio2 particles, in particular ultra-fine gold particles supported on titania, have been shown to be active for a number of reactions including low-temperature catalytic combustion and partial oxidation of hydrocarbons. The catalytic activity of these systems has been observed to be strongly structure sensitive.
The surface photoreactivity of titania particles was investigated using the reduction of silver salts (e.g. AgNo3) to metallic Ag as a probe reaction, by transfer of photoexcited electrons from the titania surface. The resolution that can be achieved with AFM is comparable to that of HRTEM, even for catalysts with very small metal particles (<5 nm) and low metal loading. AFM was used to study the effect of different factors on the growth of the metal particles. Factors such as the concentration of the metal precursor solution, the irradiation time and intensity, the excitation wavelength and the pH of the solution affect both the size and the spatial distribution of the metal nanoparticles on the titania surfaces. A variety of supported metal catalysts can be prepared in a similar fashion and can be characterized in situ using AFM. Ag/Tio2, Au/Tio2 and Ru/Tio2 catalysts have been successfully prepared by photodeposition, using both rutile and anatase Tio2 as supports. The metal size distribution can be controlled by tuning the photoreaction conditions. This is not trivial to achieve with other methods of catalyst preparation. These techniques can be a powerful tool in defining structure/activity relationships, and hold strong promise for the rational design of particle surfaces. This is crucial for applications where the surface reactivity needs to be characterized and controlled on the nanometer scale, as in heterogeneous catalysis and photocatalysis.