Microbe-templated calcite nano-fibers in Chinese Loess Plateau: Potential carbon dioxide sinker

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Burning fossil fuels is a major cause for global-warming and long-term climate change. The possibility of abrupt, near-future climate changes have attracted international attention, and resulted in growing interest in the development of carbon dioxide removal from atmosphere and alternative renewable energy resources. Carbonate minerals like calcite are natural buffers for equalizing carbon dioxide in the earth system. After systematically investigating calcite minerals in Chinese loess deposits, we have discovered that the calcite nano-fibers in Chinese Loess Plateau are well preserved in both modern and Quaternary loess deposits. The calcite nano-fibers are even well preserved in late Tertiary loess (red clay layers). Each calcite nano-fiber is a single crystal. The elongation direction is not parallel to ***c***-axis. Calcite with unusual morphology is a bio-induced product. We propose that the calcite nano-fibers are formed through the interactions between pore water and nano-fibers of certain dead cell membranes (of cyanobacteria and fungi). Nano-fibers released from the dead cells form templates for controlling the calcite precipitation. The calcite formed through this process in the vast Chinese Loess Plateau area is a stable sinker for carbon dioxide.

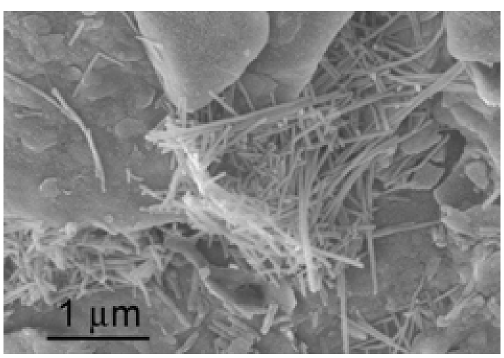

Figure 1: SEM image showing an aggregate of calcite nano-fibers from modern loess. The associated minerals are clays.

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Smart minerals for hydrogen production and environmental clean up using renewable solar energy

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Energy and environment are two challenge issues we are facing today and will face in future. Production of hydrogen can be enhanced dramatically by intergrading photocatalyst titania with tourmaline micro-crystals that have electrical polarity. The electrical field produced by tourmaline can reduce the band bending, increase the chemical potential (EF) of the electrons in titania, and enhance the separation of photogenerated electrons and holes. All these factors promote hydrogen production from water [1].

In one crystal system, shape-controlled anatase crystals dominated by {001} and {100} forms display enhanced reactivity for both photosplitting of water and photocatalytic oxidation of organic pollutants (such as volatile organic compounds in air) using renewable solar energy [2]. The results have important implications for enhancing the photocatalytic activity of titania for environmental remediation, increasing the quantum efficiency in photo-voltaic (PV) solar cells and other photo-assisted processes.

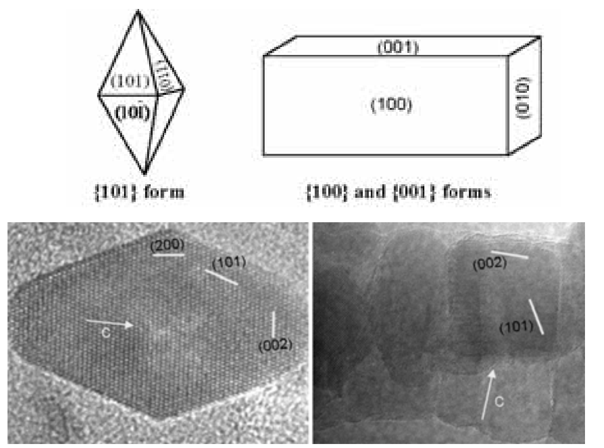

Figure 1: Normal anatase crystal with tetragonal dipyramids (left image and diagram). The elongated anatase crystal synthesized through topological replacement of titanate display shoebox-like shapes with crystal forms of {100} and {001} (right image and diagram).

[1] Yeredla & Xu (2008) *Journal of Physical Chemistry C* **112**(2), 532-539. [2] Yeredla & Xu (2008) *Nanotechnology* **19**, 055706.