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Exfoliation of Aluminum Oxide Nanosheets from a Glycothermal Precursor

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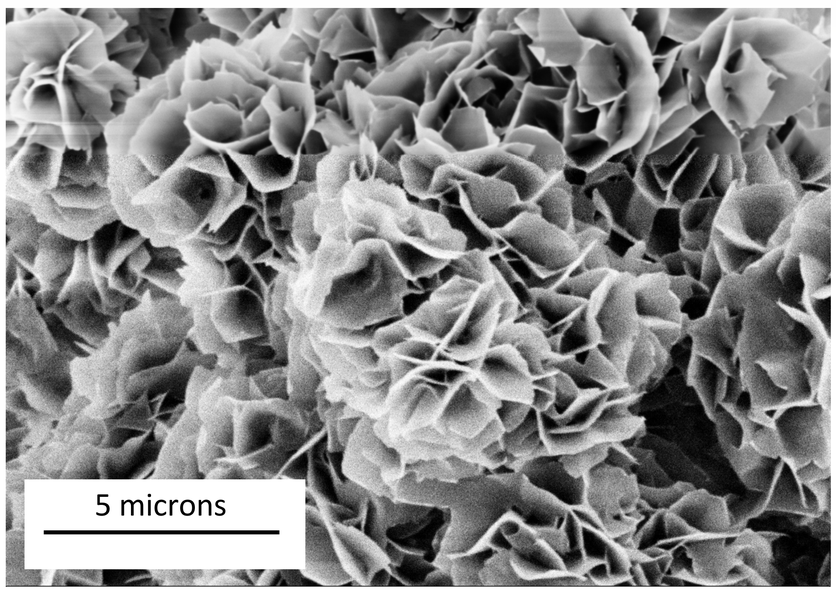
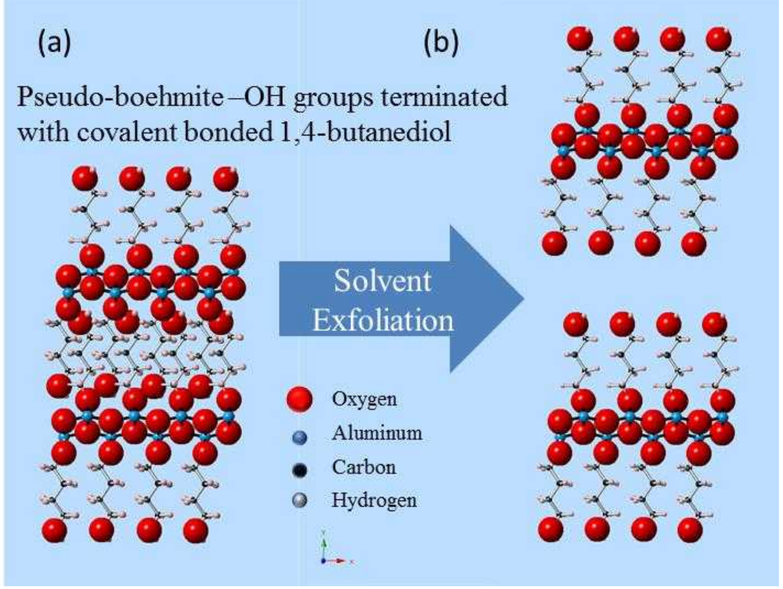
- *Novel synthesis of functionalized layers in situ is a new approach to enable new materials for exfoliation as atomic nanosheets, negating the requirement for ionic exchange or surface functionalization to reduce interlayer attractions.*
- *Pseudo-boehmite formed by glycothermal reaction of Gibbsite ($Al(OH)_3$) in 1,4-butanediol has a layered structure based on the oxy-hydroxide AlO(OH), with a surface modification of interlayer hydroxyl groups by the synthesis solvent. The weaker hydrogen bonding between primary hydroxyl groups in the interlayer allow for solvent based, shear exfoliation of atomic layers of Aluminum Oxide nanosheets.*

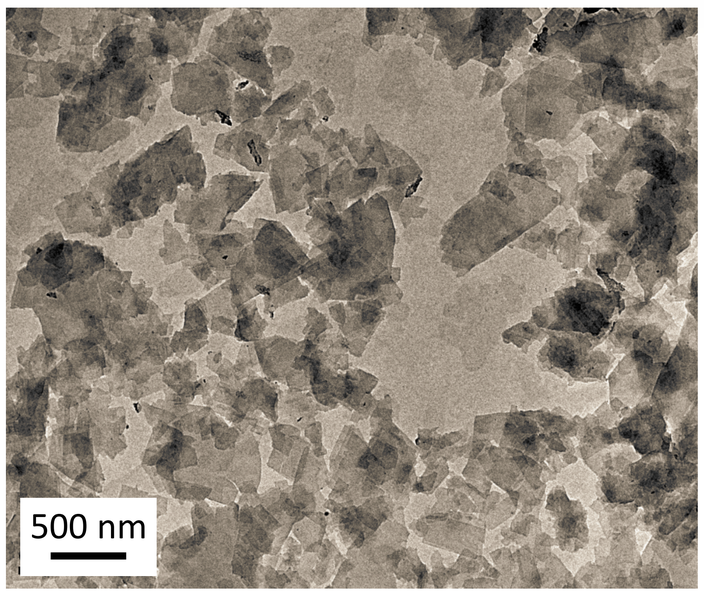
Psuedo-boehmite (As Synthesized) with a "flower-like" morphology



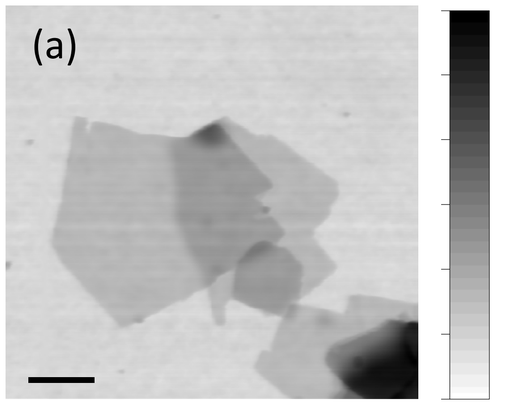
Interlayer Structure based on Boehmite layers and exfoliation to 24 Å thick nanosheets



Exfoliated Nanosheets of Aluminum Oxide

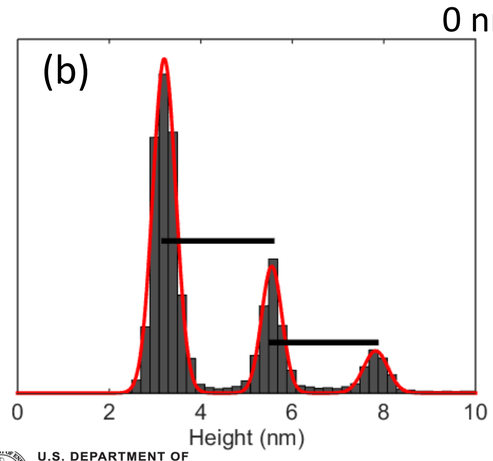


Exfoliated Layer Thickness is 2.3 nm, agreeing with the structural model.

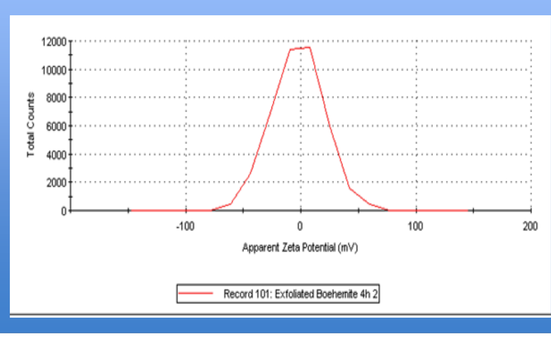


(a) A non-contact AFM image of overlapping beohmite nanosheets on an Si substrate. The scale bar is 100 nm.

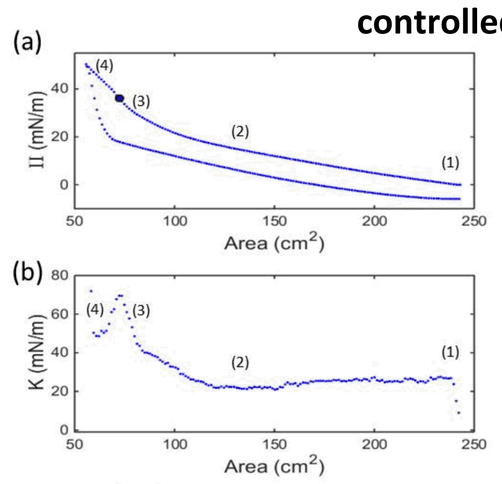
(b) A height histogram of (a) with 2.3-nm long bars indicating the thickness of the beohmite nanosheets. A Gaussian fit identifies the heights as 3.2 ± 0.2 nm (Si substrate), 4.6 ± 0.2 nm (monolayer), and 7.8 ± 0.2 nm (bilayer).

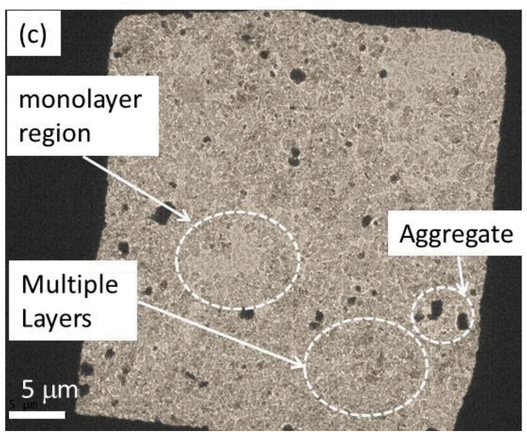


Zeta Potential verifies an uncharged exfoliation product



Nanosheets form stable Langmuir-Blodgett monolayers for controlled deposition





Summary

- Direct synthesis of a functionalized aluminum oxide phase allows for atomic nanosheet exfoliation by optimal solvent wetting.
- Nanosheets can be assembled at the fluid-air interface for film formation.
- Potential applications are being pursued in oxidation resistance and in wear properties.

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