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Selective and Enriched Nanoparticle Incorporated inside Calcite Crystals Grown in Supramolecular Hydrogels

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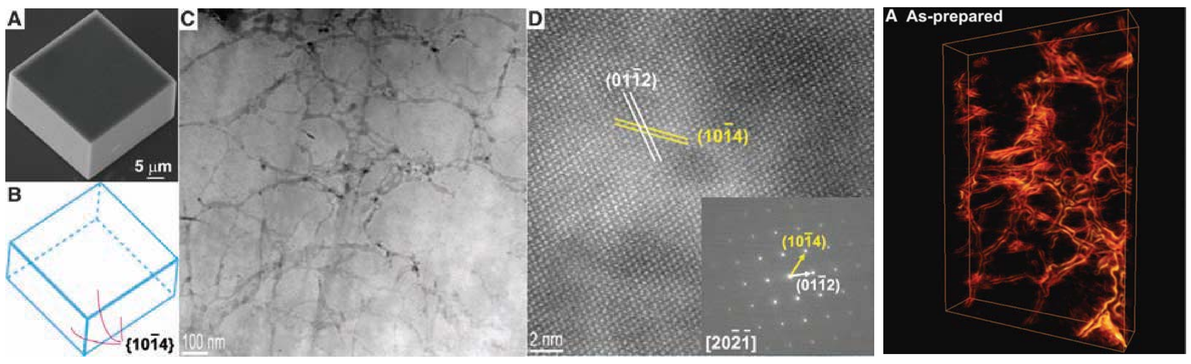
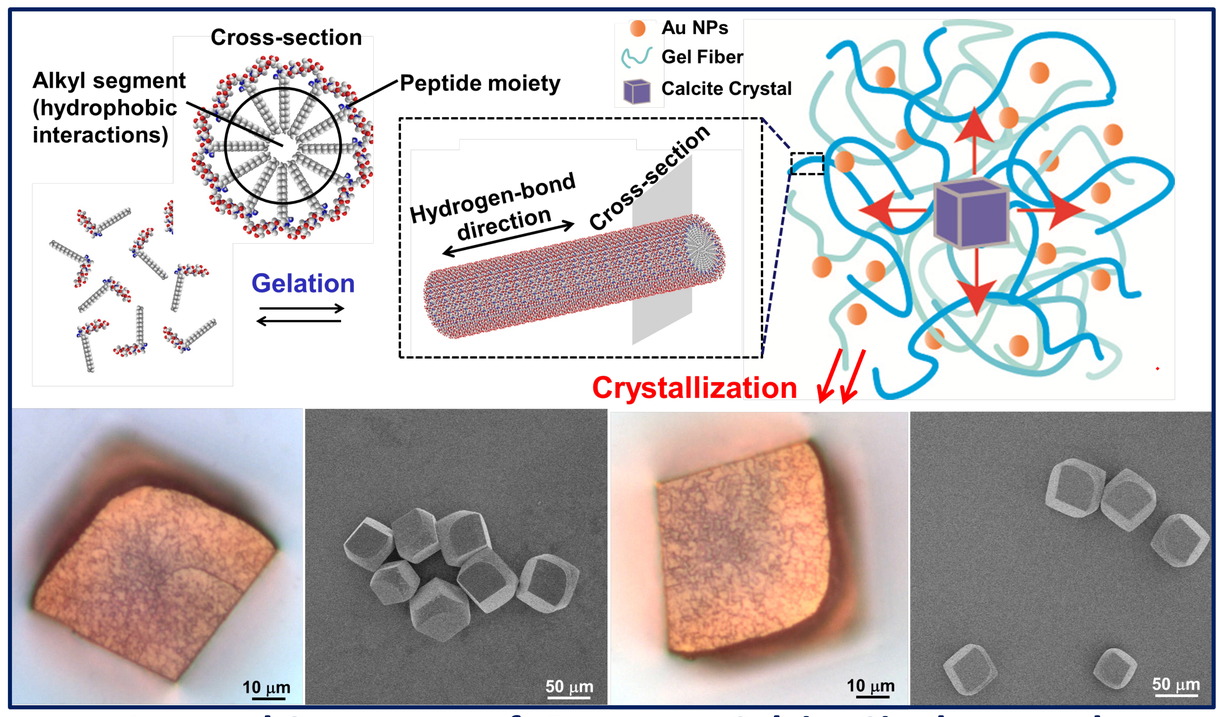
Abstract: **Single-crystal composites have been attracting increasing attention because the single-crystalline hosts can incorporate guest materials so that their properties are extrinsically regulated by the incorporated phases. However, inspired by biogenic single-crystals, the incorporating process should be facile, precise and effective regarding the demand of incorporation with high selectivity and contents. Here, Au nanoparticles were incorporated, into calcite single-crystals through supramolecular hydrogels, as a result, calcite single-crystals selectively incorporate Au nanoparticles without encapsulating gel molecules. Simultaneously, the contents of Au nanoparticles incorporated were improved originating from peptides arraying along the gel fiber. As such, our work promotes the gel method into an advanced platform to precisely regulate incorporation approach of single-crystal composites, thus expanding their potential application.**

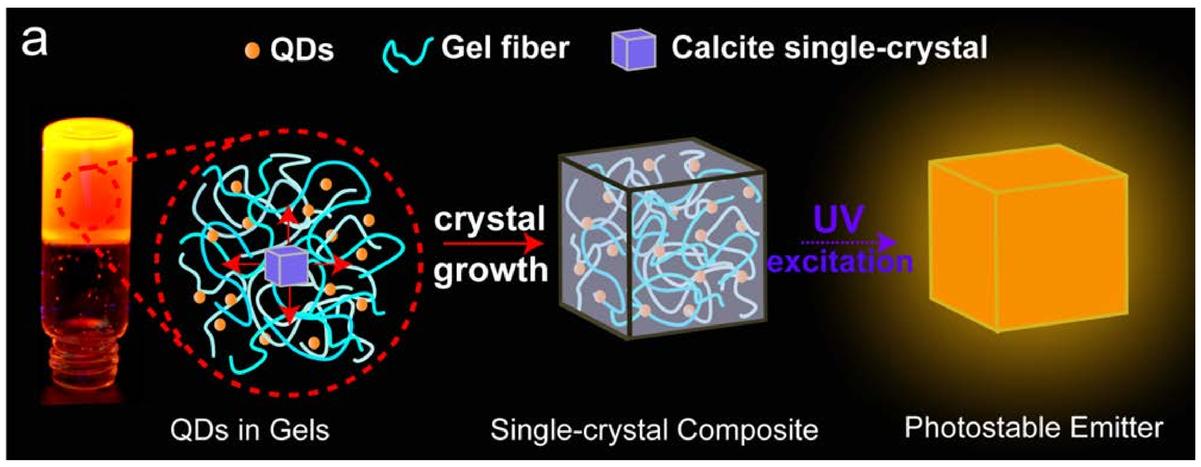
Gel-grown Calcite Single-crystal



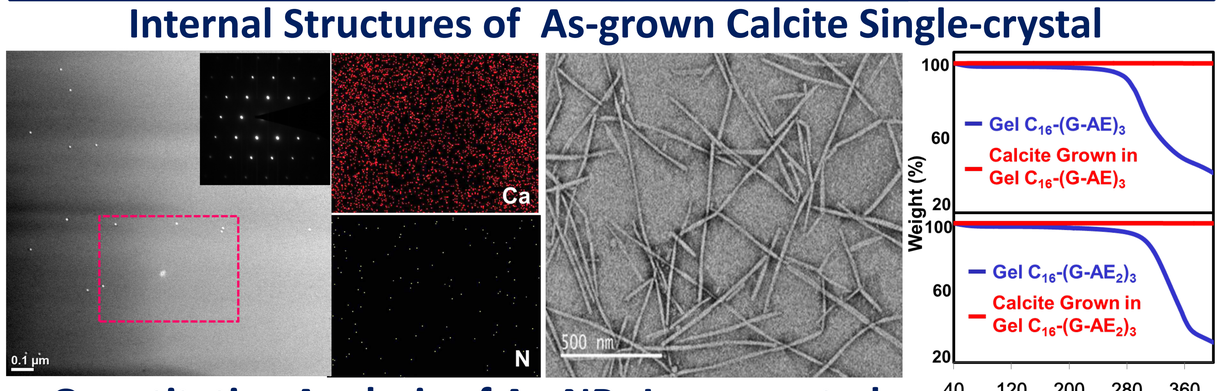
Calcite Crystals Grown in Supramolecular Hydrogels



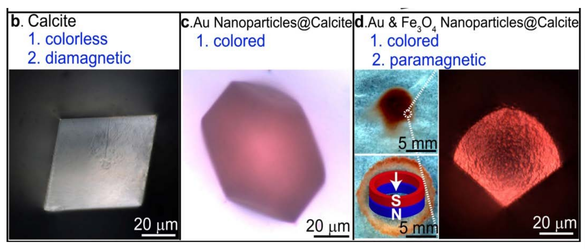
Nanoparticles Incorporation by Gel-grown Crystallization

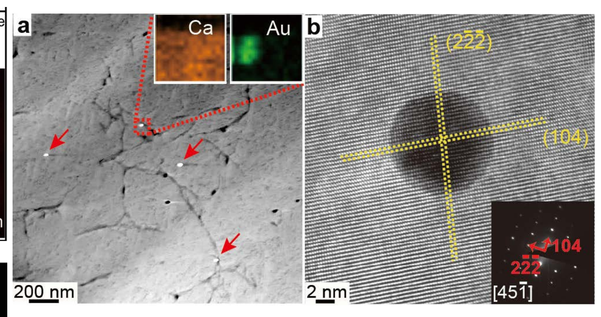


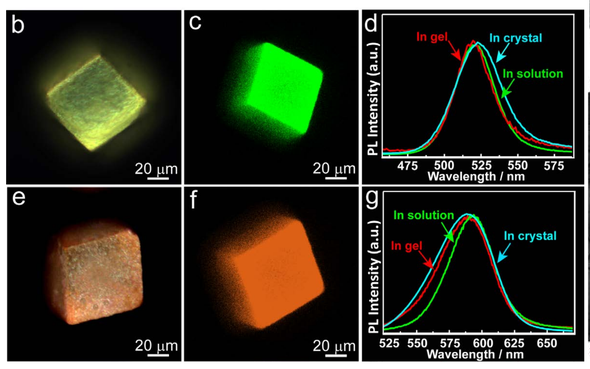
Internal Structures of As-grown Calcite Single-crystal

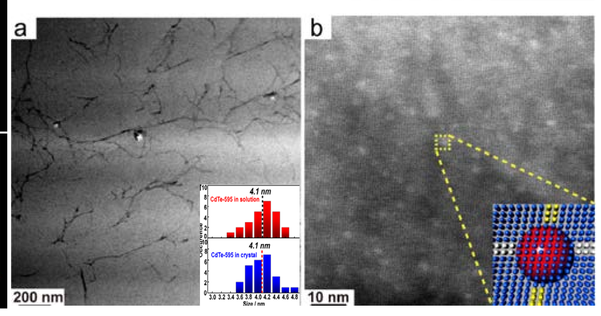


Functionalized As-grown Calcite Single-crystal

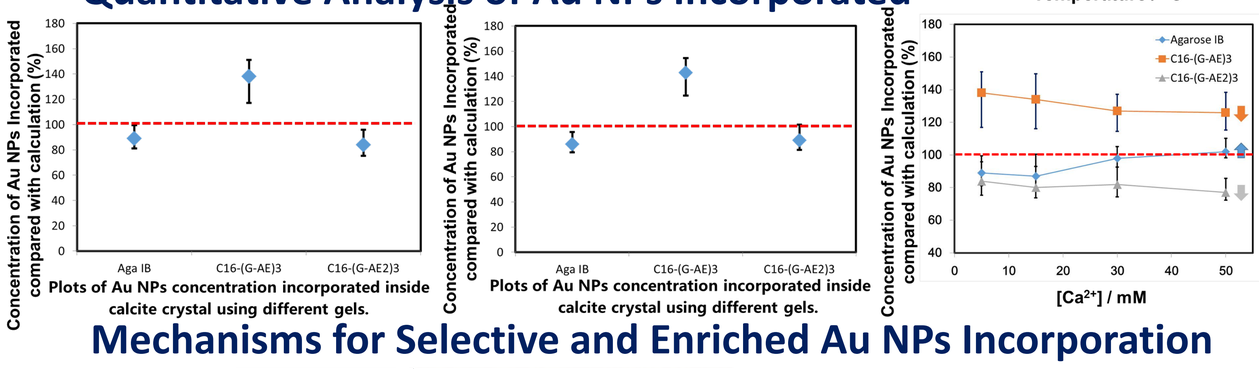




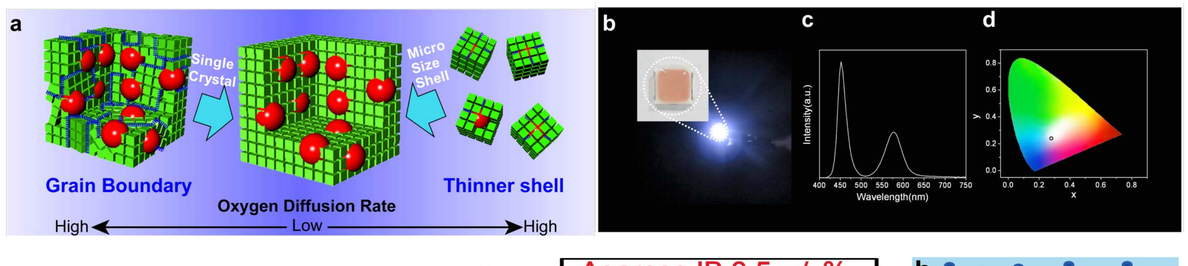




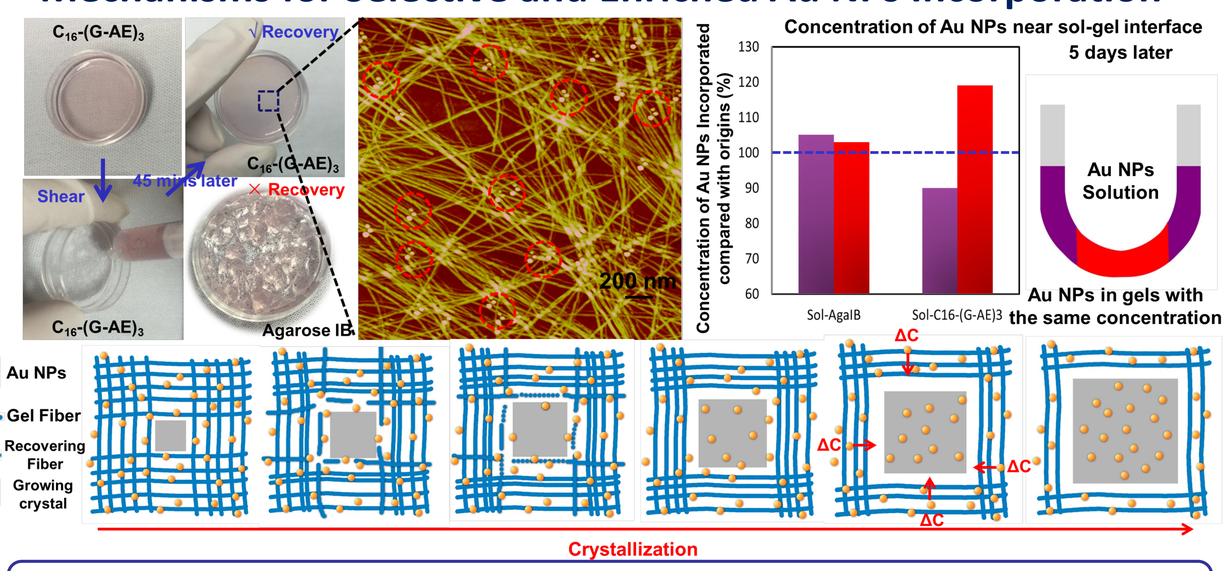
Quantitative Analysis of Au NPs Incorporated



Effect of Single-crystal Shell and Application in LED Device

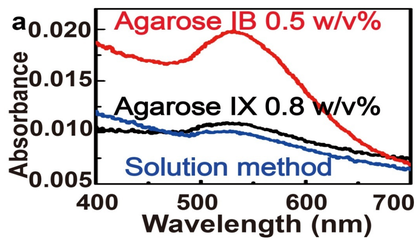


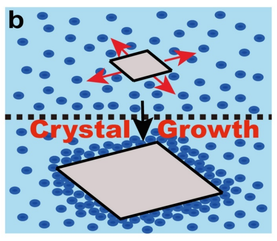
Mechanisms for Selective and Enriched Au NPs Incorporation



Incorporation Mechanism:

Crystals incorporate gel network and also the **nanoparticles trapped** in gels.





Challenges

Gel networks serve as the media for incorporation but do not provide functionalization for the crystal hosts. It will be desired to remove the gel networks from the crystals.

The concentration of NPs incorporated is relatively low using gel method.

Conclusions

- The gel-grown calcite single-crystals **selectively incorporate** the Au NPs without encapsulating the weak supramolecular gels.
- The concentration of Au NPs incorporated inside calcite grown in gel **C_{16}-$(G\text{-}AE)_3$** is improved by **40 %**, compared with those dispersed in other gel media.
- The **selectivity** and **enrichment** of Au NPs incorporation is due to the **recoverable** and **self-assembled** properties of supramolecular gels, as well as the high concention of **peptides arraying** outside the fibers.

Acknowledgement

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