Single-Crystal Composites

Functionalizing Single-Crystals: Nanoparticle Incorporation Inside Gel-Grown Calcite Crystals

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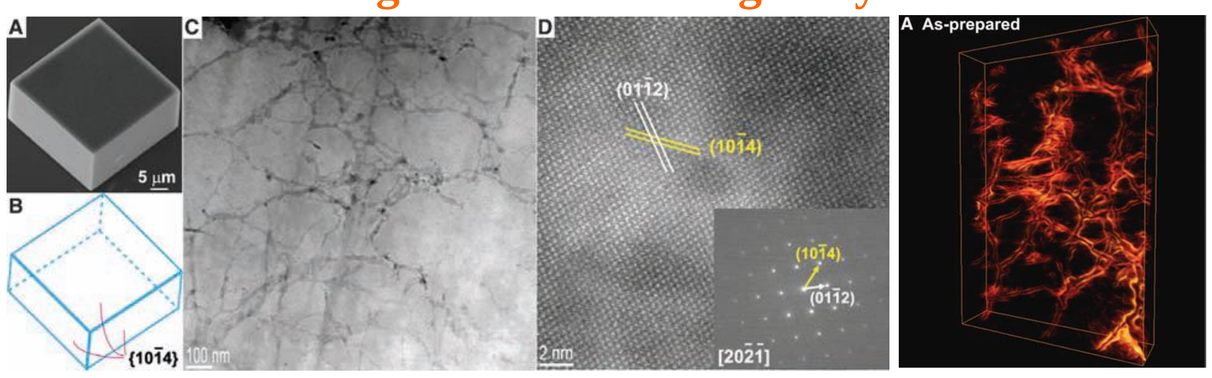
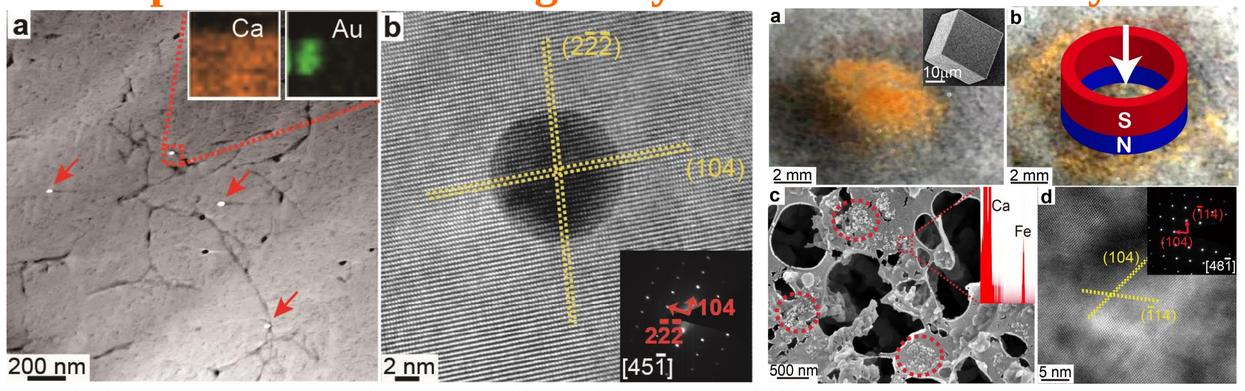
Synthetic single-crystals are usually homogeneous solids. Biogenic single-crystals, however, can incorporate biomacromolecules and become inhomogeneous solid so that their properties are also extrinsically regulated by the incorporated materials[1,2,3,4,5,6]. Here, Au, Fe_3O_4 and QDs nanoparticles were incorporated, through a gel-grown crystallization method, into calcite single-crystals and, as a result, calcite single-crystals were turned into colored, paramagnetic fluorescent solids[7]. Surprisingly, the stability and fluorescence lifetime of QDs were improved originating from the single-crystal host. As such, our work extends the long-history gel method for crystallization into a platform to functionalize single-crystalline materials to expand their potential application.

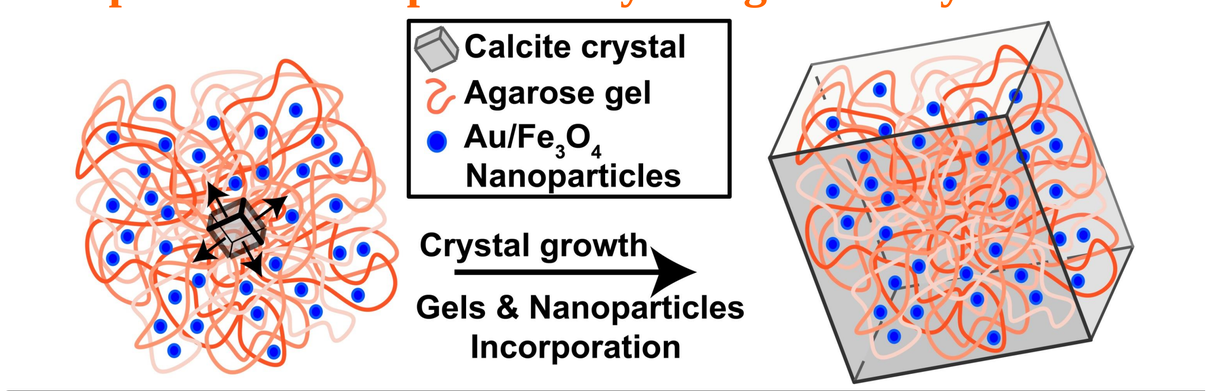
Gel-grown Calcite Single-crystal

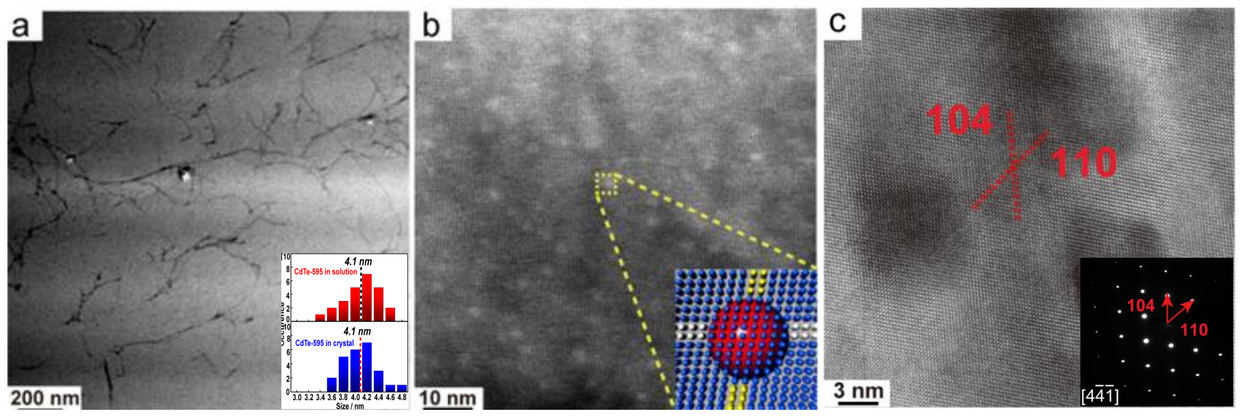


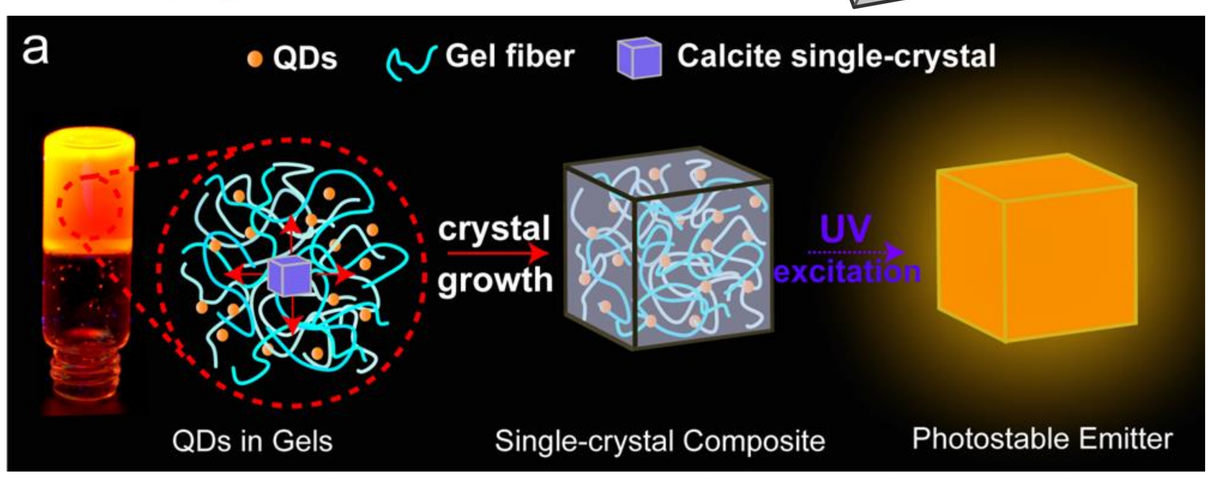
Nanoparticles inside Single-crystal Characterized by EM



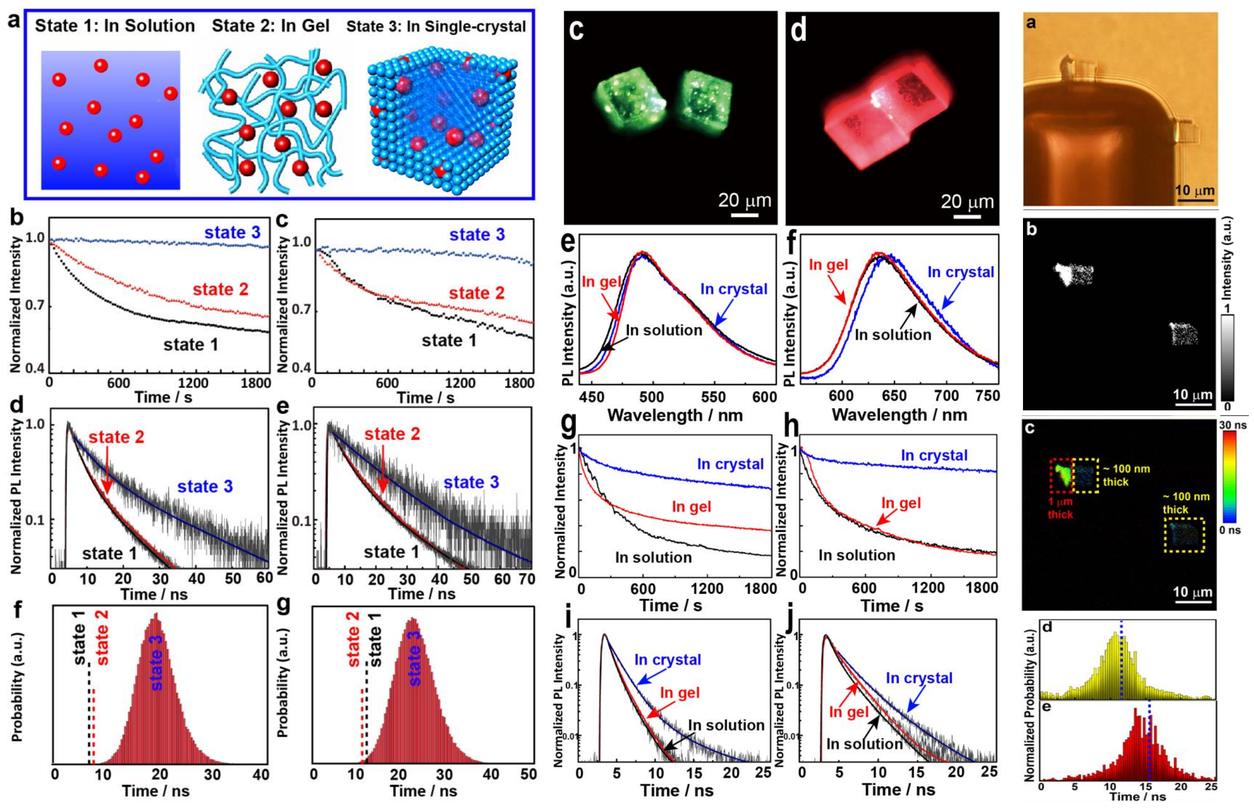
Nanoparticles Incorporation by Gel-grown Crystallization



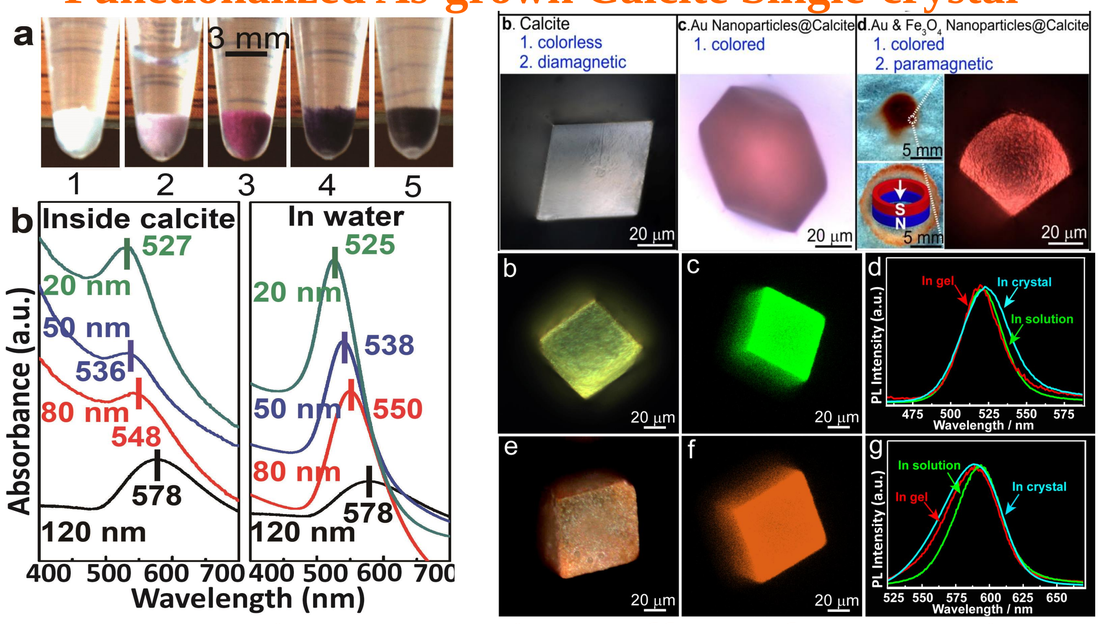




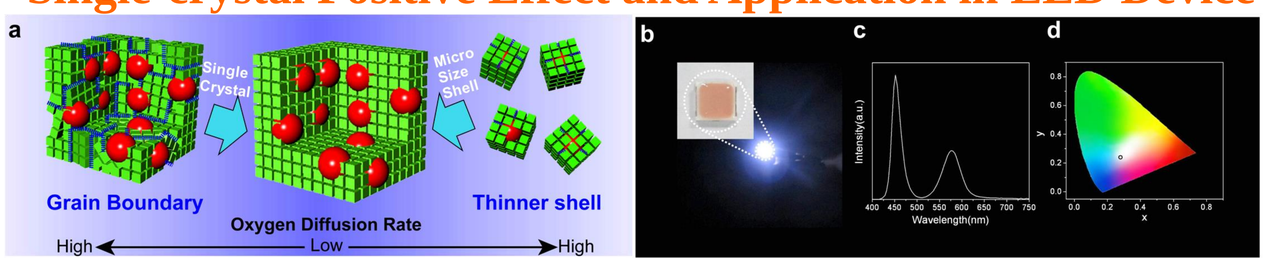
Improved Stability and Fluorescence Lifetime of QDs inside Crystal



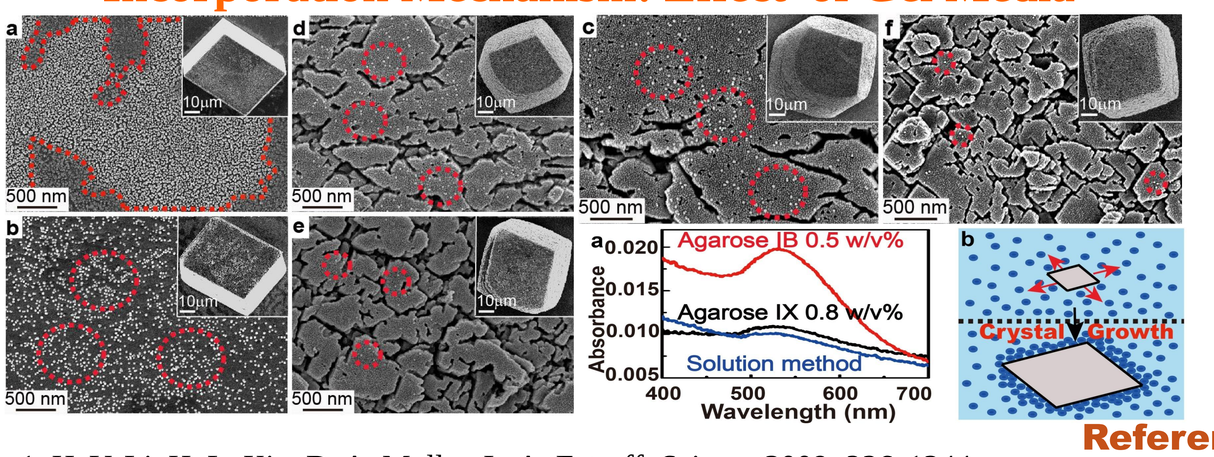
Functionalized As-grown Calcite Single-crystal



Single-crystal Positive Effect and Application in LED Device



Incorporation Mechanism: Effect of Gel Media



Conclusions

- The **optical** and **magnetic functionalization** are achieved through nanoparticle incorporation inside the calcite single-crystals.
- **Gel growth media** instead of solutions are necessary to induce the nanoparticle incorporations during which crystals incorporate the gel network and also the **nanoparticles trapped** in the gels.
- The improvement of **stability** and **fluorescence lifetime** of QDs is due to the nature of single-crystsal, demonstrating **benifits** on nanoparticle from **single-crystal host**.

References

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Acknowledgements

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