

Supporting Information

Al₂O₃/Yttrium-compound core-shell structure formation with burst nucleation: a process driven by electrostatic attraction and high surface energy

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Table S1. The residual ions in the solution after filtration measured by the inductively coupled plasma emission spectrometer (ICP-AES, IRIS Intrepid II XSP, Thermo Electron Corporation, USA). It is confirmed that there is little Y ions washed away.

The stoichiometry of YAG can be realized with high precise.

Element	1 st filtration (ppm)	2 nd filtration (ppm)	3 rd filtration (ppm)
Al	0.03(1)	0.03(1)	0.01(1)
Y	0.45(2)	0.13(1)	0.24(1)

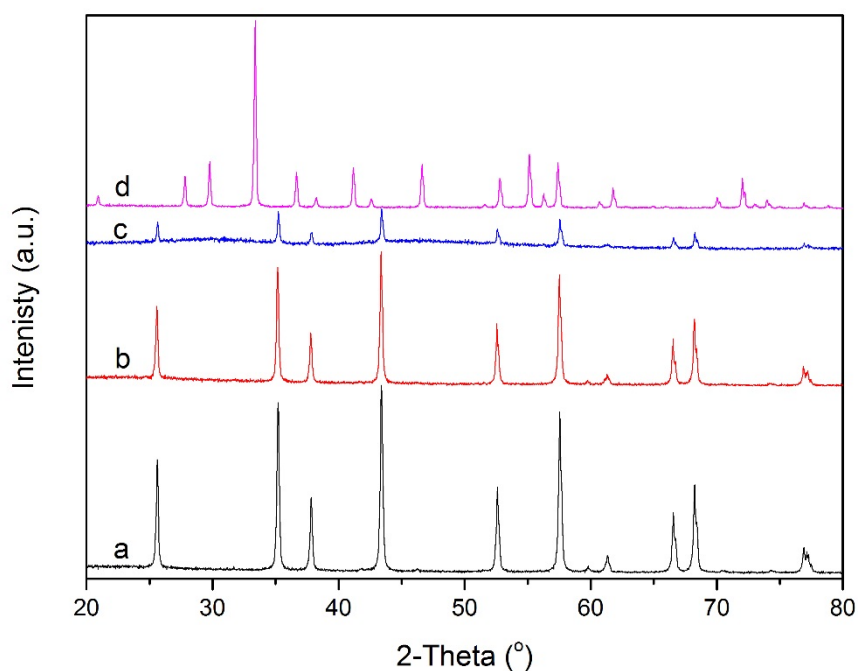


Figure S1. XRD patterns of α - Al_2O_3 (a); the mid-product precursor obtained from the suspension at pH=2.6 (b); the YAG precursor obtained from the suspension at pH=6.8 (c); and YAG particles calcined at 1250°C for 2h (d).

The XRD patterns (a-c) are similar and all corresponding to rhombohedral Al_2O_3 (α - Al_2O_3 , PDF#10-0173). The difference is that the diffraction intensity become weak with reaction process and there is an amorphous diffraction is noticed in pattern (c) around 30 °. It implies the increase of the shell thickness during the homogeneous precipitation process. XRD pattern (d) is identified as pure $\text{Y}_3\text{Al}_5\text{O}_{12}$ phase (PDF#72-1315), indicating a complete phase transition.

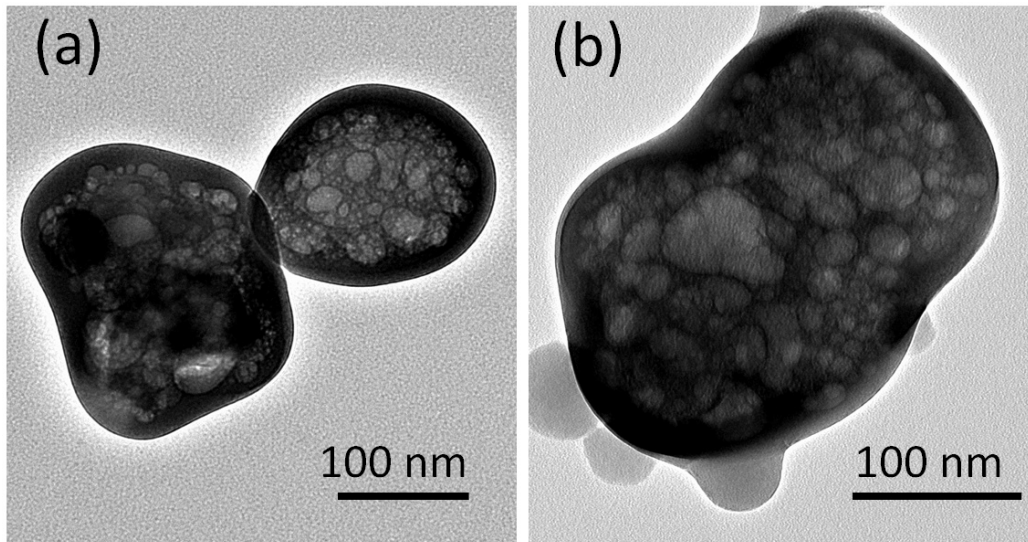


Figure S2. The final YAG precursor under high electron explore. The surface of the material is easily decomposed. Based on the stability of $\alpha\text{-Al}_2\text{O}_3$ and the unstability of Y-compounds, the shell structure is deemed as Y-compound.

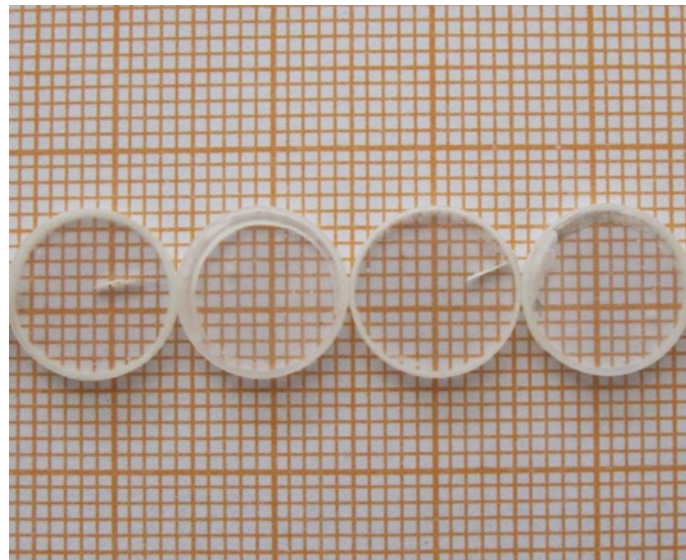


Figure S3. The photographs of the as-obtained transparent ceramics sintering from the powders obtained via the partial wet chemical route. The transparency of the ceramics are good, indicating the good sintering property of the as-obtained YAG powders.

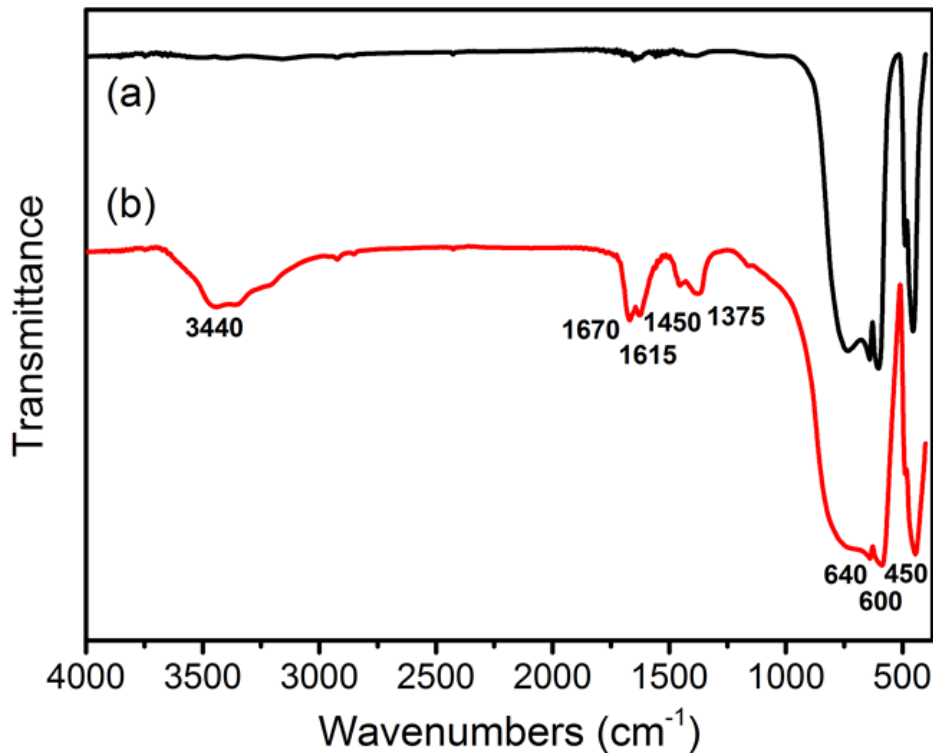


Figure S4. FTIR spectra of the pure Al₂O₃ (curve a), Al₂O₃-NH₄HCO₃ (curve b) in the synthesis process.

To certificate if the carbonate group can adsorb on the surface of Al₂O₃, FTIR spectrum of Al₂O₃ nanoparticles collected from Al₂O₃-NH₄HCO₃ was taken. The FTIR spectrum of Al₂O₃-NH₄HCO₃ (Fig. S4, b) have characteristic adsorption of OH⁻ groups whose peak at 1670 and 3700-3000 cm⁻¹ centered at 3440 cm⁻¹, CO₃²⁻ whose peak at 1375 and 1450 cm⁻¹, is quite different from the FTIR spectra of pure Al₂O₃ (Fig. S4, a). It indicates that the surface of bar Al₂O₃ can adsorb some groups hydrolyzed from NH₄HCO₃ after intense stirring in Al₂O₃-NH₄HCO₃ system.

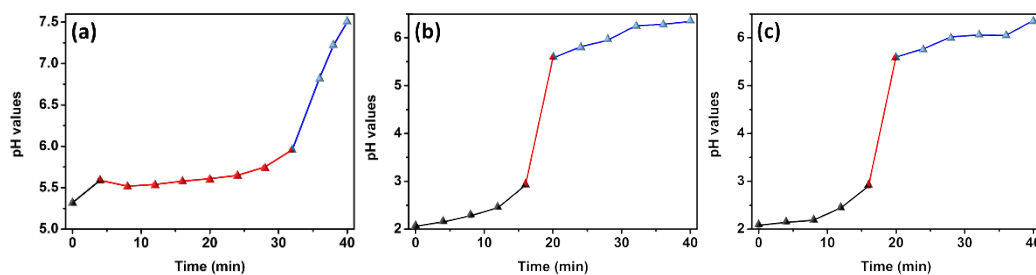


Figure S5. The pH evolution of different reaction system: $\text{Al}_2\text{O}_3\text{-Y}(\text{NO}_3)_3\text{-NH}_4\text{HCO}_3$ system (a), $\text{Al}_2\text{O}_3\text{-Y}(\text{NO}_3)_3\text{-Urea}$ system with PAA as surfactant (b), and $\text{Al}_2\text{O}_3\text{-Y}(\text{NO}_3)_3\text{-Urea}$ system (c).