Environment-Conscious Preparation Method for Robust and Transparent γ-Alumina with an Aerogel-like Porosity

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Porous alumina has been utilized extensively as adsorbents, catalysts, catalyst supports and others, and yet cost-effective and environmentally-friendly synthetic routes are sought after for the materials with a higher porosity. We present a new preparation method for highly porous γ-alumina that replaces the cumbersome supercritical drying process with a new liquid-removal process based on biofuel. The products are obtained as transparent particles after post-synthetic calcination at ~ 700 °C for over 10 hours. Their BET surface areas of ~ 288 m^2/g are comparable to other porous γ-alumina but the materials have much larger pores with a peak maximum at ~60 nm in the BJH adsorption dV/dlog(D) curve and show a BJH cumulative pore volume of 2.06 cc/g. The products are much more robust and are not subject to capillary collapse when soaked in liquids, such as rare earth salt solutions, forming crystalline rare earth aluminates after subsequent heating. TEM images support the presence of mesopores and the BET analysis suggests negligible presence of micropores in the pore structure. The γ-alumina particles can be post-synthetically stabilized with a small amount of silica so that no phase transition is observed up to ~1100ºC. We anticipate high-temperature solid state chemistry in the nano-sized pores of the new materials for preparation of inorganic composites.