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Investigation of mineral beyerite ($CaBi_2O_2(CO_3)_2$): As a multifunctional material

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Heterogeneous catalysis and photocatalysis have emerged as the most sought after research topics towards minimizing the environmental impacts from unwanted and harmful chemical products. The nontoxic and stable mixed metal oxides such as $BiVO_4$, Bi_2WO_6, and BiOX containing Bi^{3+} cation offer an interesting choice for semiconductor photocatalysis. Apart from $BiVO_4$, other bismuth containing compounds such as Bi_2MoO_6, Bi_2CuO_4 and $Bi_2O_2CO_3$ have been investigated extensively. Most of these materials are being made into different heterostructures in order to improve the photocatalytic efficiency especially under visible light irradiation. $Bi_2O_2CO_3$belongs to the sillen family and is an intergrowth of $[Bi_2O_2]^{2+}$ layers and $(CO_3)^{2-}$ layers formed in such a way that the plane of the $(CO_3)^2$ group is orthogonal to the plane of Bi-O layers. The other bismuth carbonate known as mineral beyerite, $CaBi_2O_2(CO_3)_2$has been relatively less explored. Beyerite has the $[Bi_2O_2]^{2+}$ layers along with the additional Ca^{2+} ions and the layer sequence is $(Bi_2O_2)^{2+}$- CO_3^{2-}- Ca^{2+} - CO_3^{2-}- $(Bi_2O_2)^{2+}$. Herein, we present bismuth calcium oxy carbonate; $CaBi_2O_2(CO_3)_2$ synthesized via single step solvothermal route and the Rietveld refinements of the PXRD measurements confirmed the structure (S G Immm, a=3.76283(5) Å; b=3.75493(8) Å; c=21.6611(5) Å). Corroborating results from other basic characterizations i.e. Fourier transformed infrared (FT-IR), thermogravimetric analysis (TGA), Raman, ultra-violet diffuse reflectance spectroscopy (UV-DRS) and field emission-scanning electron microscopy (FE-SEM) of this mineral will also be presented. Experimental details and significant results showing the mineral's ability to perform as a catalyst, photocatalyst and as a luminescent host will be included.

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