Synthesis of mesoporous Au/TiO₂ nanocomposites by HDP method: An efficient reusable photocatalyst for dye degradation under UV & sunlight

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Gold supported mesoporous titania nanocomposites have been synthesized by homogeneous deposition-precipitation (HDP) method and used as an effective photocatalyst in photodegradation of organic dye pollutant (Figure 1, Table 1). XRD patterns show the exclusive existence of anatase crystalline phase of TiO₂. The incorporated Au NPs exists in its metallic state, where the particles have diameters ~6-12 nm. The Au/TiO₂ catalysts showed very good photocatalytic activity compare to commercial TiO₂ (Degussa P25) in degradation of alizarin red dye under UV irradiation as well as sunlight. The enhancement in the photocatalytic activity is due to the strong interaction between metallic gold nanoparticles and anatase titania support. The Au NPs act as effective trapping centers to prevent recombination of electron-hole pairs, making the catalysts even active under sunlight for the efficient degradation of dye like pollutants. Another attractiveness of the present photocatalyst lies in its easy separation from the cleaned solution and reusability. The reusability studies of the photocatalyst exhibited more than 98% degradation of the dye

even after 10 consecutive cycles. The finding in this study reveals a new class of photocatalyst and a possible pathway by which various chemical reactions on the photocatalyst can be driven with sunlight at ambient temperatures for environmental remediation and fine chemical production.

Table 1: Textural properties of mesoporous TiO₂ and different wt% of Au/TiO₂ catalysts.

Au loading (wt%)	Au content ^a (wt%)	Surface area ^b (m ² /g)	V _t (cc/g)	D _{BJH} (nm)
0.0	0.00	186	0.32	6.9
1.0	0.85	169	0.28	6.7
2.0	1.55	141	0.21	6.3
3.0	2.54	130	0.20	6.2
4.0	3.58	119	0.19	6.1

^aGold content measured by ICP-OES.

^bBET method; V_t : total pore volume; D_{BJH} : average pore diameter calculated by BJH adsorption method.

Figure 1: Schematic diagram of the synthesis and photocatalytic application of mesoporous Au/TiO₂ nanocomposites