Cu_2O decorated Mesoporous TiO_2 beads as a highly efficient photocatalyst for hydrogen productions

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Cu_2O decorated mesoprous TiO_2 beads are developed as a low-cost, highly efficient photocatalyst for hydrogen productions. Mesoporous TiO_2 beads with a high specific surface area of 189 m^2/g, a large pore volume of 0.43 cm^3/g, and a suitable pore size of 8.9 nm, are decorated with nontoxic, band structure matched Cu_2O nanocrystals through a facile, fast, and low cost chemical bath deposition process. The Cu_2O nanocrystals serve as an electron-hole separation centre to promote hydrogen evolutions. By tuning the concentration of the Cu_2O precursor, the loading amount of Cu_2O can be controlled. At optimal operation conditions, an ultrahigh specific hydrogen evolution rate of 223 mmol/hr g in the absence of light shielding and a large hydrogen evolution rate of 6.644 mmol/hr at a photocatalyst loading of 0.05 g, are achieved. The success is attributed to the structural advantages of the mesoporous TiO_2 beads of high specific surface areas, large pore volumes, and suitable pore sizes, together with much improved electron-hole separations and better light utilization of the Cu_2O decorated mesoporous TiO_2 beads. The hydrogen evolution rates achieved with the Cu_2O decorated mesoporous TiO_2 beads are one order of magnitude higher than those by commercial P25 TiO_2.