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| Title: | High and reversible oxygen uptake in carbon dot solutions generated from polyethylene facilitating reactant-enhanced solar light harvesting |
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| Abstract: | Solar-driven photocatalysis is emerging as a key chemical transformation strategy due to its favourable energy economy. However, in photocatalytic oxidation reactions where molecular oxygen (O2) is a reactant, achieving higher efficiency requires an O2-saturated environment in order to maintain a high oxygen level on the catalyst surface, necessitating an additional energy-consuming step of O2 separation from air. Here we show that in the presence of carbon quantum dots (CQDs), the oxygen content and the ability of O2 to diffuse in water increase significantly. We first demonstrate a novel strategy to convert several grams of polyethylene, a stubborn pollutant, into highly photoactive CQDs by stepwise dehydrogenation and graphitization. In a typical CQD concentration of ~1 mg ml−1, the oxygen level in water reaches ~640 μM, double that of pure water inferring an extremely high O2 content of ~1 wt% associated with CQDs under ambient conditions. Therefore, when the CQDs were used to catalyze photo-oxidation of aromatic alcohols by sunlight, the efficiency was found higher than previous instances despite those employing high oxygen pressure, temperature and expensive materials. Besides waste polyethylene utilization, the uniqueness of oxygen enrichment in CQD solutions may offer immense prospects including those in photo-oxidation reactions. |
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