



Hydrothermal growth of ZnO nanorods on Zn substrates and their application in degradation of azo dyes under ambient conditions

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Abstract: A new type of catalytic material, large-scaled ZnO nanorod arrays grown on self-source substrate, was directly synthesized by a facile hydrothermal approach. The catalytic activity of the ZnO nanocrystals with different exposed surfaces, including ZnO hexagonal nanorods with exposed reactive {0001} facets, hexagonal ZnO nanopyramids with the nonpolar {01 $\bar{1}$ 0} planes, and pencil-like morphology with exposed {10 $\bar{1}$ 1} polar planes, was tested towards the degradation of the azo dyes (Congo red (CR) and methyl orange (MO)). The aqueous azo dyes can be degraded efficiently under ambient conditions, requiring neither light illumination nor additional energy (agitation, ultrasonic, etc.). Systematic experiments suggested that the dye degradation proceeds through the electron transfers from the anionic dye molecules to the catalyst and then to electron acceptors such as dissolved oxygen. It strongly depends on the exposed polar surfaces of the ZnO nanocrystals, giving rise to the relative higher catalytic activity and stability of the ZnO hexagonal nanopencils. The present ZnO nanorods arrays grown on Zn substrate requires no additional reagents or external energy input, which hence provides a potentially low-cost alternative for the remediation of azo-dye effluents.

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Sažetak

Nova vrsta katalitičkog materijala: nanoštapići ZnO deponirani na Zn podlogu izravno su sintetizirani hidrotermalnom metodom. Katalitička aktivnost ZnO nanokristala s različitim izloženim ravninama, (ZnO šesterokutni nanoštapići s izloženim reaktivnim {0001} plohama, šesterokutna ZnO nanopiramida s nepolarnim {01-10} plohama, i olovka morfologija s izloženim {10-11} polarnim ravninama) je testirana pri degradaciji azo bojila (Congo red (CR) i metil orange (MO)). Vodene azo boje mogu se ovim katalitičkim postupkom učinkovito razgraditi pod ambijentnim uvjetima bez dodane energije (svjetlo, zvuk, toplina). Sustavno provedeni eksperimenti ukazuju da se degradacija bojila odvija preko prijenosa elektrona iz anionske molekule bojila na katalizator, a zatim do akceptora elektrona poput otopljenog kisika. To uvelike ovisi o izloženim polarnim površinama ZnO nanokristala, doprinoseći relativno višoj katalitičke aktivnosti i stabilnosti ZnO šesterokutne olovka morfologije