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Synthesis of freestanding amorphous ZrO_2 nanotubes by anodization and their application in photoreduction of Cr(VI) under visible light

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Abstract

13.6 µm long ZrO_2 nanotubes were fabricated by anodization in fluoride ethylene glycol added to it K_2CO_3. The addition of K_2CO_3 in the electrolyte was found to weaken the adherence of the anodic film from the underlying Zr. This produced freestanding ZrO_2 nanotubes in a form of loose flakes. The as-anodized ZrO_2 nanotubes were amorphous with surface area of 25.3 m^2/g. The amorphous ZrO_2 nanotubes were then used to adsorb and reduce Cr(VI) in aqueous solution under visible light illumination. The presence of hydroxyl and carbonate groups on the surface of the nanotubes may have improved the adsorbent property of the nanotubes. Once the Cr(VI) ions were adsorbed on the oxide, they were reduced by photoelectrons generated when ZrO_2 was illuminated. High concentration of oxygen vacancies and Zr^{3+} defects, as well as the incorporation of carbon atoms into the ZrO_2 lattice may have influence the formation of free electrons for photoreduction process to occur.

Keywords: zirconia; nanotubes; photoreduction; hexavalent chromium; adsorption