

## Accepted Manuscript

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PII: S0257-8972(16)31314-7  
DOI: doi: [10.1016/j.surfcoat.2016.12.026](https://doi.org/10.1016/j.surfcoat.2016.12.026)  
Reference: SCT 21883  
To appear in: *Surface & Coatings Technology*  
Received date: 31 August 2016  
Revised date: 2 December 2016  
Accepted date: 8 December 2016

Please cite this article as: Nurulhuda Bashirom, Khairunisak Abdul Razak, Zainovia Lockman, Synthesis of freestanding amorphous ZrO<sub>2</sub> nanotubes by anodization and their application in photoreduction of Cr(VI) under visible light. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Sct(2016), doi: [10.1016/j.surfcoat.2016.12.026](https://doi.org/10.1016/j.surfcoat.2016.12.026)

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# Synthesis of freestanding amorphous ZrO<sub>2</sub> nanotubes by anodization and their application in photoreduction of Cr(VI) under visible light

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## Abstract

13.6 µm long ZrO<sub>2</sub> nanotubes were fabricated by anodization in fluoride ethylene glycol added to it K<sub>2</sub>CO<sub>3</sub>. The addition of K<sub>2</sub>CO<sub>3</sub> in the electrolyte was found to weaken the adherence of the anodic film from the underlying Zr. This produced freestanding ZrO<sub>2</sub> nanotubes in a form of loose flakes. The as-anodized ZrO<sub>2</sub> nanotubes were amorphous with surface area of 25.3 m<sup>2</sup>/g. The amorphous ZrO<sub>2</sub> 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<sub>2</sub> was illuminated. High concentration of oxygen vacancies and Zr<sup>3+</sup> defects, as well as the incorporation of carbon atoms into the ZrO<sub>2</sub> lattice may have influence the formation of free electrons for photoreduction process to occur.

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

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