NANOTUBES FABRICATED BY ANODIZING PROCESSES FOR ADVANCED MATERIAL APPLICATION

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In recent years, research in nanotube materials has been developed into many new areas since the discovery of carbon nanotubes in 1991. Specifically, many important metal oxides with non layered structure such as TiO_2, ZnO, MnO_2, ZrO_2, and Co_3O_4 have attracted attention in the fabrication of nanotube structures, despite the high rigidity of the crystal structure. Most of the important progress includes fabrication of the metal oxide nanotubes from anodic aluminum oxide templates (AAO) and supramolecular templates with various sol-gel methods that transfer materials onto inner or outer surfaces of templates.

Under this circumstance, Zwilling et al. have anodically grown highly porous oxide layer on pure Ti and Ti-6Al-4V alloy in chromic acid solution without or with hydrofluoric (HF) acid addition. They proposed that the growth and pore formation process obey a growth-dissolution mechanism caused by the local competition between Cr(VI) and F^- species.

In the present study, we report the fabrication of nanotubes, especially formed on pure Ti and Zr foils, by anodization in 0.5 wt.% HF solution. By combining various anodizing conditions with the amount of chromic acid additive, it is possible to control the length and the hole size of the TiO_2 and ZrO_2 tubes, as well validated by HR-SEM images. For high mechanical strength of these tubes, we employed various heat treatments, which stabilize the tube structure. The results support the introduction of an easy electrochemical method to fabricate the highly directional nanotubes on valve metals. The generalized growth mechanism will be discussed on the basis of the film growth-and-dissolution process.

References

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