Synthesizing ordered porous silicon oxide layer by horizontal nonlinear anodization approach

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Anodic oxidization of aluminum had been proved to be an effective method in corrosion protection of aluminum[1] , and ordered porous anodic oxide aluminum had been widely applied in areas such as catalysis carrier sensor and display devise[2-8] . Conventional anodic oxidization of aluminum had been investigated for decades, and corresponding self-ordered formation of porous anodic alumina film had been well investigated [9-15], and the reported growth rate of film was 1-3 μm/hr. Anodic oxidization of aluminum at high current density and formation of ordered film with growth rate of 1-3 μm/min had been found, nonlinear anodization and mechanism accounting for faster growth was proposed [16]. Further, anodizing aluminum horizontally was applied in this report to synthesize ordered porous anodic alumina, and based on horizontal anodization, various silicon oxide films were synthesized by performing anodic oxidization in mixture containing sulfuric acid and colloidal component that is derived from hydrolysis of ethyl silicate (ES). Two steps anodizing in which first anodic oxidization was carried out in sulfuric acid and second in mixed solution was performed and a novel type of compound oxide comprising porous silicon oxide and anodic alumina was produced. Ordered porous silicon oxide with morphology similar to anodic alumia was also fabricated. This investigation provides satisfactory experimental results supporting the speculation that ordered microstructure can be build by flowing gas in colloid, and previously proposed mechanism of oxide growth during nonlinear anodization is also discussed to be valid. Moreover, a new route of synthesizing porous media through performing anodizing in colloidal solution is discovered.

Keywords: horizontal anodizing, nonlinear anodization, anodic alumina, Ethyl Silicate, porous silicon oxide.

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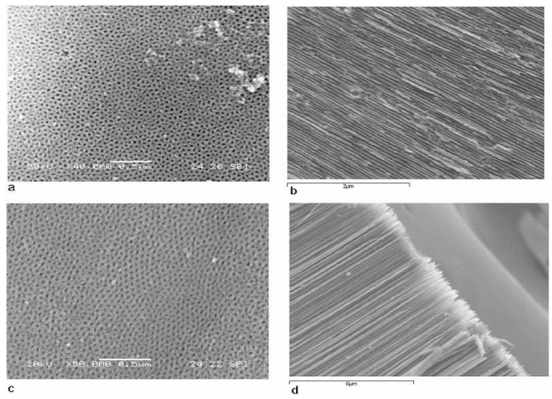

Figure1 Micrograph of anodic aluminum oxide, a,b, aluminum anodized vertically, c,d aluminum anodized horizontally; a,c surface view, b, d, cross section view.

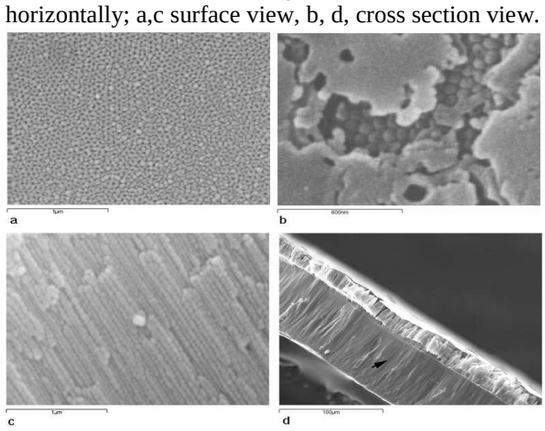

Figure2 Micrograph of ordered or non-ordered silicon oxide layer supported by aluminum oxide through two steps anodization, a,b, surface view ; c, d, cross section views .

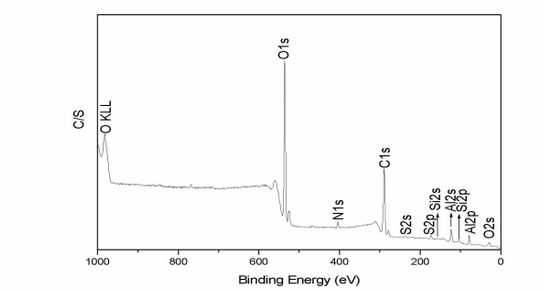

Figure 3 X-ray Photoelectron Spectrum of sample prepared by two steps anodization, the second anodizing performed in mixture solution containing colloidal silicon oxide.