

Title: Impedimetric transduction from a single-step thin film nanoporous aluminum oxide as a DNA sensing electrode

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Abstract: A two-step anodization process has been widely used to grow a perfectly arranged Anodic Aluminum Oxide (AAO) nanoporous with high regularity and circularity. However, this method requires more time and electricity cost since the second step anodization will be conducted more than a couple of hours up to 24 h to obtain a perfect hexagonally arranged AAO. Besides, the usage of toxic chromic acid to remove the rough surface after the first anodization is not recommended. To solve this issue, a single-step of anodization method to grow AAO at 15 °C in 0.3 M of oxalic acid at 40 V for 1 h has been proposed. In this study, the growth AAO thin film will be tested as a DNA biosensor electrode. Prior to that, instead of using toxic chemicals, couple of drops of phosphoric acid solutions were used to treat the rough, uneven surfaces by promoting hydroxyl groups while at the same time widening and revealed the underneath pores. The AAO thin film is ready for the next step of surface modification without a second anodization step. Surface chemical functionalization using 3-aminopropyl-triethoxysilane (APTES) and glutaraldehyde is performed to immobilize the aminated-ssDNA probe on the surface. The electrochemical impedance technique is employed to monitor the changes in each layer of surface modifications. The charged transfer resistance (R_{ct}) values are linearly increased with each new additional layer on the AAO surfaces during each step of surface modification and with the increase in ssDNA complementary target concentrations (10 fM-10 μ M). From the performance test, the single-step AAO thin film electrode has shown great results in functioning as a DNA biosensor through a selectivity test. It has the capability to differentiate the complementary sequences from the single mismatched target with 3-fold.

Keywords: Nanoporous thin films, DNA biosensor, Single-step anodization, Oxalic acid, Phosphoric acid treatment, Surface modification, 3-aminopropyl-triethoxysilane (APTES), Glutaraldehyde

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