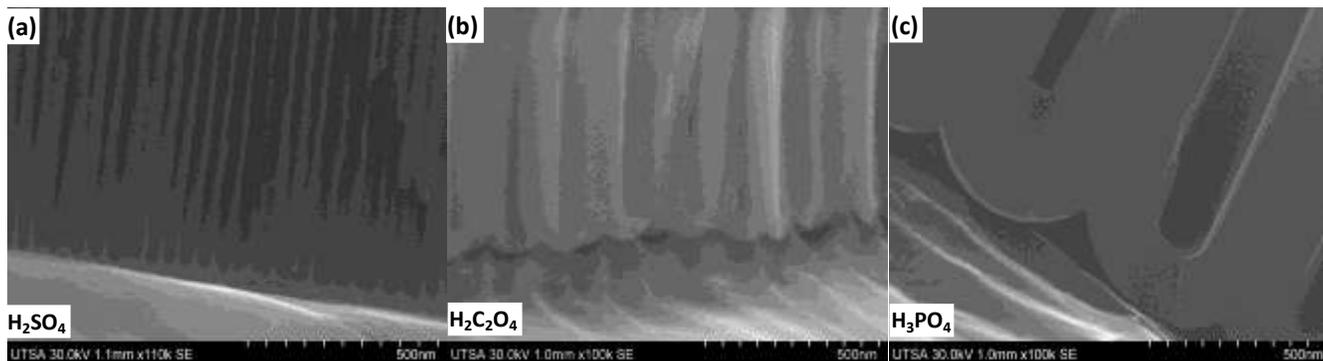


CHARACTERIZATION OF SILVER NANOWIRE GROWTH IN POROUS ALUMINUM OXIDE TEMPLATES PRODUCED EMPLOYING SULPHURIC, OXALIC AND PHOSPHORIC ACIDS

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Abstract:

We report the growth of Silver Nanowires with varying diameters in porous anodic aluminum-oxide (AAO) membranes by Electroless deposition approach. This objective was carried out in 2 phases. In Phase 1, AAO membranes on high purity Aluminum foils were electrochemically grown by a 2-step anodization procedure, and three different electrolytes such as Sulphuric acid (H_2SO_4), Oxalic Acid ($\text{H}_2\text{C}_2\text{O}_4$) and Phosphoric Acid (H_3PO_4) were employed to produce membranes with varying pore diameters (Figure 1). Other parameters such as Interpore distance, Barrier Layer and membrane thickness were also explored that are critical in the fabrication of Silver Nanowires. The observed template growth rate is lowest in Phosphoric acid ($\sim 1.12 \mu\text{m}/\text{hour}$), and highest in Oxalic acid ($\sim 11.63 \mu\text{m}/\text{hour}$), whereas the Pore diameter, Interpore distance, and Barrier layer thickness increases in the following order: $\text{H}_2\text{SO}_4 < \text{H}_2\text{C}_2\text{O}_4 < \text{H}_3\text{PO}_4$. In addition, pore-widening characterization to modify the pore diameter and barrier layer opening of free standing AAO templates has been carried out. In Phase 2, Electroless deposition of Metallic Silver nanowires was carried out with varying pore diameters AAO membranes. AAO membranes immersed in aqueous silver nitrate solutions were thermally reduced at 350°C for duration of 1 hour, and grown silver nanowires were examined with a SEM, as shown in Figure 2. For future work, we plan demonstrate free standing nanowires by employing self-assembled monolayers.



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Figure 1: Cross Sectional view of AAO membranes grown in different electrolyte solutions, (a) Sulphuric Acid (H_2SO_4), (b) Oxalic Acid ($\text{H}_2\text{C}_2\text{O}_4$), and (c) Phosphoric Acid (H_3PO_4)

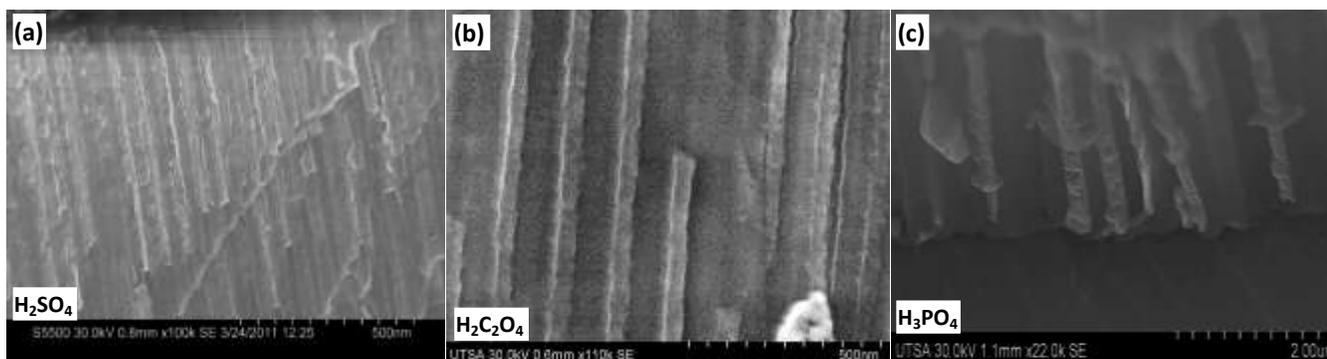


Figure 2: Silver Nanowires grown in AAO membranes by Electroless deposition, (a) Sulphuric Acid (H_2SO_4), (b) Oxalic Acid ($\text{H}_2\text{C}_2\text{O}_4$), and (c) Phosphoric Acid (H_3PO_4).