

Fabrication of Large-Scale 50nm Nanopore Arrays on Polytetrafluoroethylene

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1 Motivation

- Efficient heat transfer mechanisms are imperative for achieving high power density and system efficiency in advanced electronic systems and cryogenic applications.
- Enhancement in heat transfer can be achieved by nanotexturing the surface.
- The excessive nucleation sites and hydrophilic nature of the nanoporous surface modify and enhance heat transfer.

2 Introduction

- Ordered, large scale nanopore arrays are textured on polytetrafluoroethylene by inductively coupled reactive ion (ICP-RIE) etching.
- 50nm average pore size anodic aluminum oxide (AAO) templates are used as an etching mask.

Why Teflon can be a better alternative?

- Low friction coefficient– minimal frictional heat loss
- Chemical inertness to most reactive and corrosive fluids - cryogenic fluid transportation

3 Experimental Details

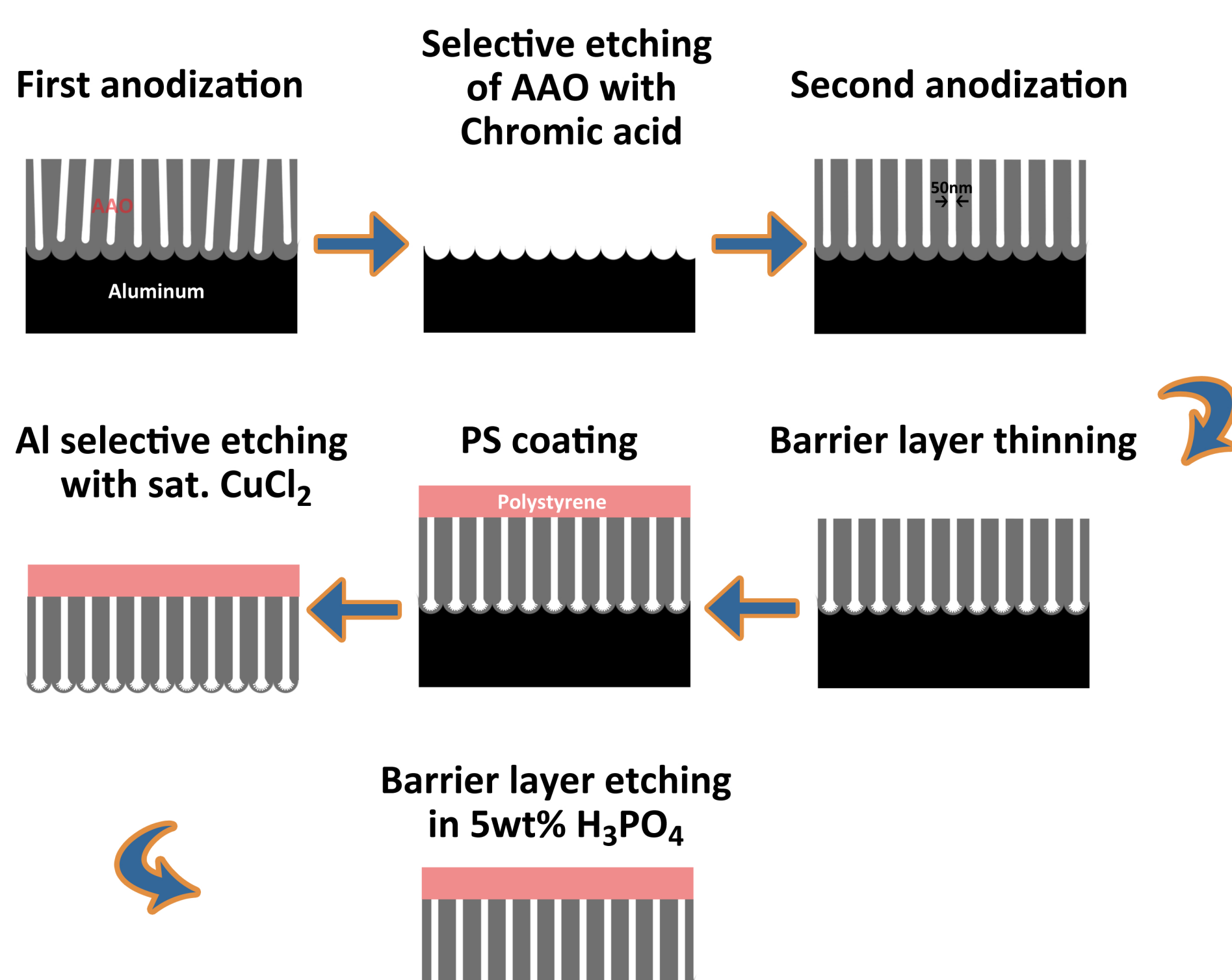


Figure 1: Schematic illustration of fabrication of 50nm average pore size AAO templates at 40V in 0.3M oxalic acid solution.

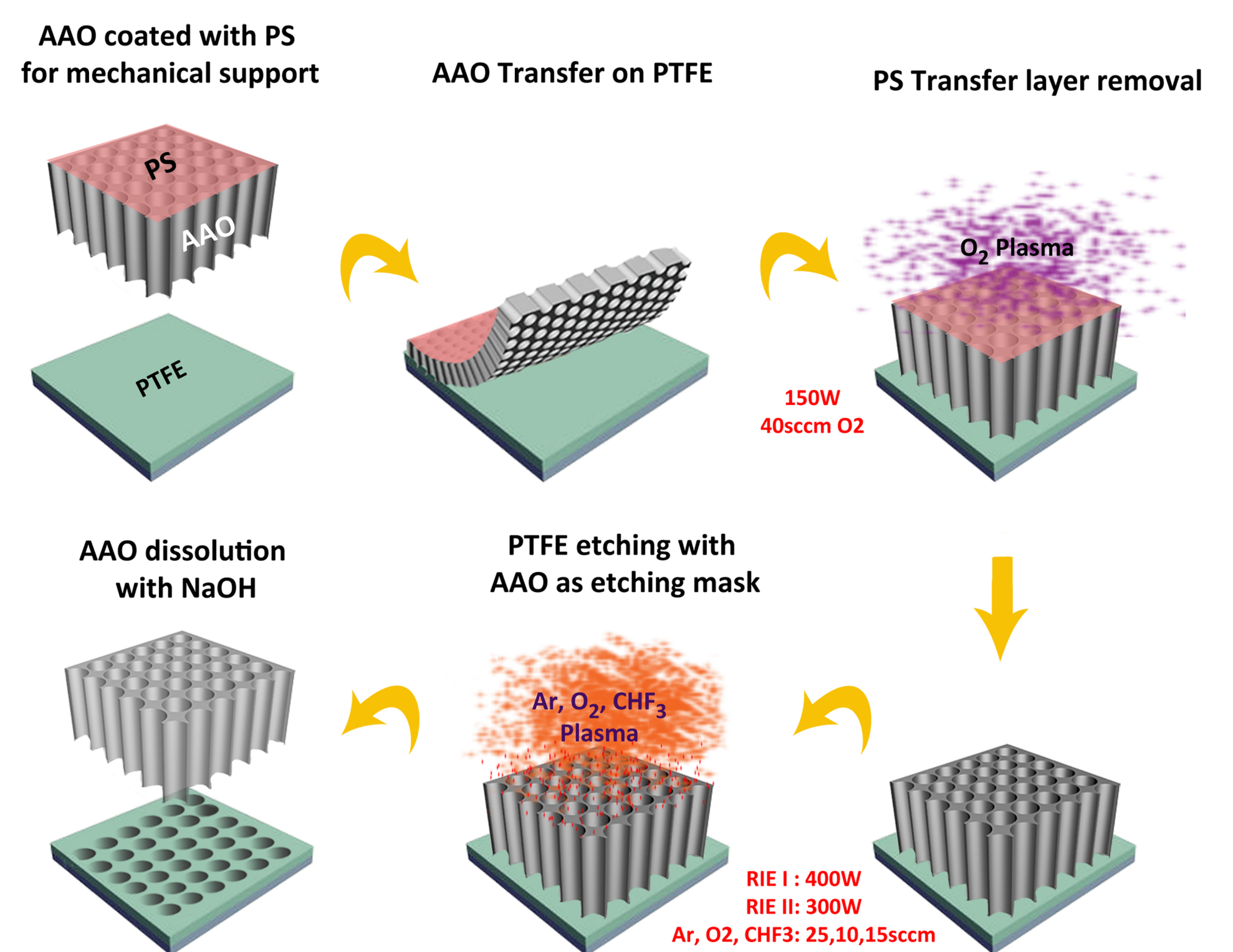


Figure 2: Schematic illustration of the ICP-RIE technique used in the fabrication of ordered, large scale nanopore array texturing in polytetrafluoroethylene.

4 Results

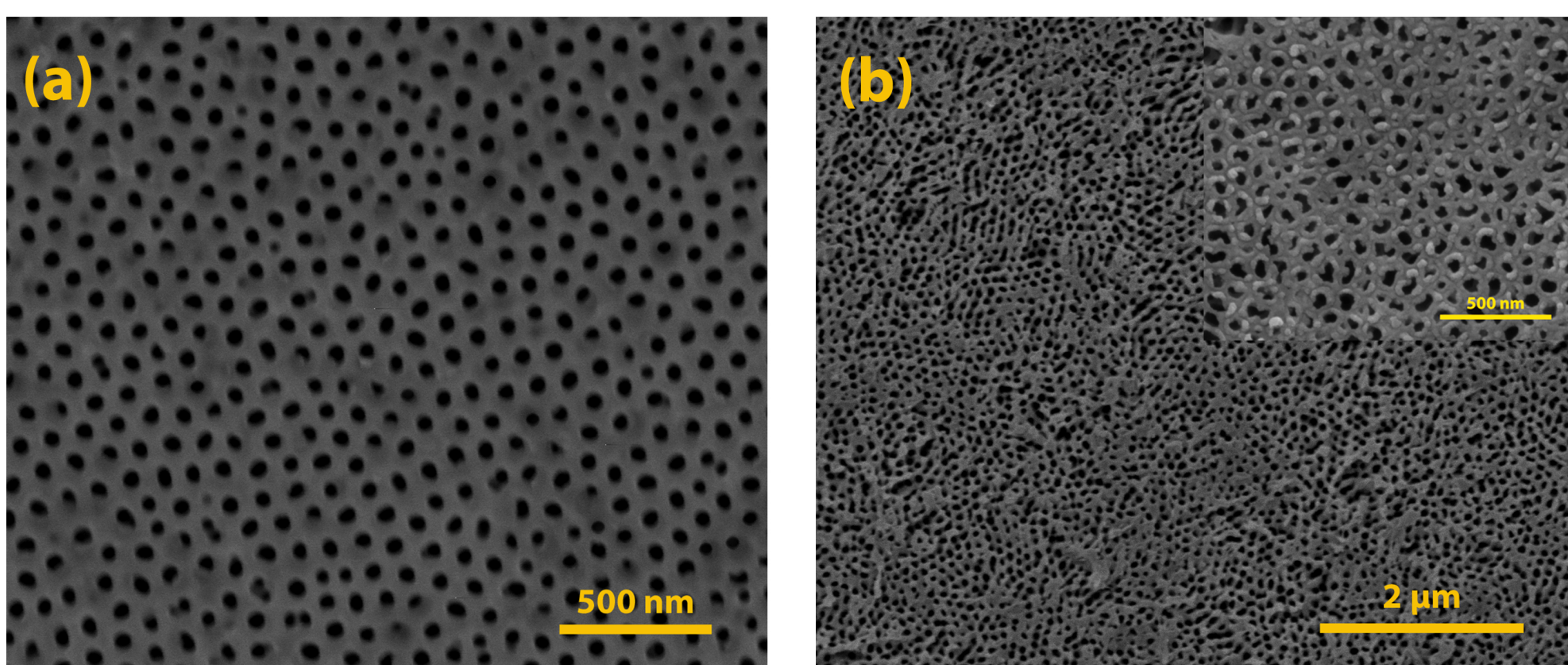


Figure 3: SEM image of (a) anodic aluminum oxide with an average pore diameter of 50nm fabricated by two step anodization process in 0.3 M Oxalic acid solution and (b) ordered, large-scale hexagonal array of nanopores textured on polytetrafluoroethylene using ICP-RIE technique with AAO templates as etching mask.

5 Conclusions

- Large-scale, ordered nanopore arrays were fabricated on PTFE by ICP-RIE technique with AAO as an etch mask.
- Two-step anodization in 0.3M oxalic acid was carried out to fabricate 50nm average pore sized AAO template.
- AAO barrier layer was removed using barrier layer thinning and H_3PO_4 etching process.
- A mixture of argon, CHF_3 and oxygen plasma chemistry was used to selectively etch and transfer the hexagonal pore pattern of AAO onto PTFE.
- A DC-bias accelerating power of 300W was required to drive the plasma into the AAO pore structure and etch the PTFE substrate.

Acknowledgements

