# Advances in Anodic Alumina MCP development

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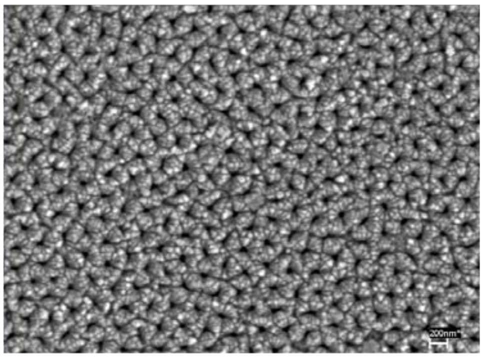
## Anodic alumina as a potential material for MCP production:

- **Effective secondary electron emitter.**
- **Possible to produce structure of necessary geometry.**
- **Surface of plate is up to 50*50 mm.**
- **Thickness is from several up to 250 µm.**
- **Channels diameter from 10 to 250 nm (natural porosity).**
- **The technology exist to produce samples with any required channels diameter starting from about 5 µm.**
- **Recent results allow to be optimistic concerning AAO electric resistance reduction.**

**AAO structure:**



## Problem 1:

**Natural AAO MCP have too big electric resistivity (>10 GOhm) to be a good MCP.**

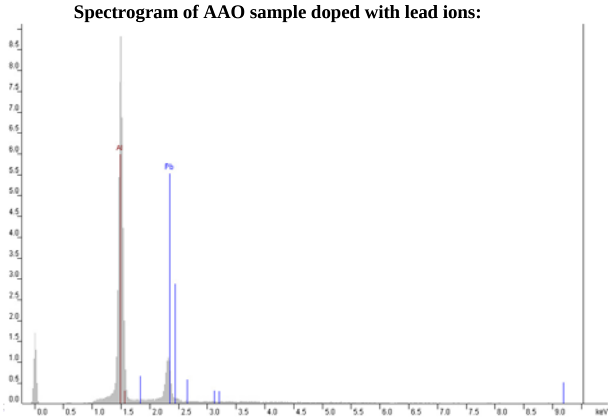
### Three possible methods to increase conductivity:

**1) growth of AAO MCP from alloys of alumina and some metals;**
**2) use of modulated tension generator during process of AAO electrochemical production;**
**3) deposition of conductive layers on MCP surface and on walls of channels.**

### Results:

**1) Growth from allows doesn't work**
**2) Modulated tension allows up to date to incorporate Pb and Mo, but resistivity didn't changed, because metal must be activated – an appropriate technology is under development.**
**3) A deposit of conductive material on walls inside of channels gives the best results up to date.**

**Spectrogram of AAO sample doped with lead ions:**




**Different methods can be applied to deposit conductive material on walls inside of channels. Nickel and magnesium oxide were tried up to date. Good results were obtained with deposit of nickel films.**
**Electric resistivity and secondary emission coefficient were studied for the produced samples. It was found that doped samples have secondary emission coefficient around one and electric resistance at room temperature is vary from 4 MOhm to several hundreds MOhm.**

## Problem 2:

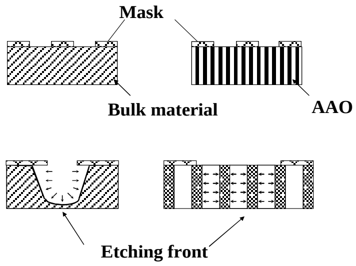
**Natural AAO MCP have too big operational aspect ratio (OAR) to be a good MCP . Maximal gain of MCPs is achieved at OAR in a region from 30 to 60 (depending on voltage) and then gain fail to one at ratio around 80-120. And, an AAO with natural porosity have channel length to diameter ratio in a region from 100 to 25000.**

### A possible solution is to form channels of necessary diameters by etching through mask.

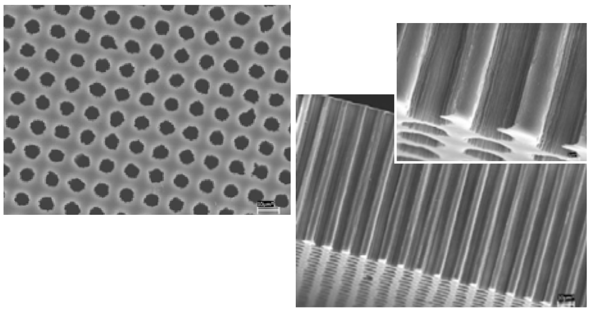
**The developed procedure of anodic alumina MCP production consists of next stages:**

- **growing of anodic alumina of necessary thickness;**
- **separation of alumina plate from aluminum substrate;**
- **deposition of photolithographic mask;**
- **protection of non-operational surface;**
- **etching of alumina through protective mask in multi-component acidic and alkaline etchings;**
- **liberation of MCP matrix;**
- **annealing of MCP matrix.**

**The difference of etching processes in bulk and porous (right) materials:**




**Etched AAO MCP samples:**



## Conclusion:

**• A technology to increase electric conductivity of AAO was developed. New samples have resistance around tens of MOhm. The resistivity can be varied in wide region depends on the technological production parameters.**
**• An etching technology, which has a characteristic "anisotropy" due to porous structure of the AAO is also developed. Produced channels are open-ended and have constant diameter along the full depth of a plate. However, a technology optimization is still required. We plan to reach 150-180 µm of MCP thickness with conserving of the MCP structure parameters.**