

Report of the MCP Godparent Review Committee

Andrey Elagin(Chicago) - Co-Chair, Jason McPhate(UCB/SSL), Mike Pellin (ANL-MSD), Erik Ramberg(Fermilab), John Smedley(BNL), Anton Tremsin(UCB/SSL), Bob Wagner(ANL-HEP)

Version 2.1

01 May 2013

1. Summary Assessment

The review committee recognizes the impressive progress of the microchannel plate program and thanks all the presenters for the efforts and the quality of their presentations. With the replacement of molybdenum with tungsten as the metallic component of the resistive chemistry, the gain uniformity has been greatly improved. It appears the ALD group is able to reproducibly produce targeted resistances. The MCPs potentially have much better operational characteristics than lead-glass based MCPs in terms of pre-conditioning, lifetime, and robustness. A lot of instructive test work on the MCPs has been done at both SSL/Berkeley and at the UV laser test area at the Argonne APS. Finally, we recognize the excellent work and commitment of Incom to the MCP program. Glass capillary array quality has been steadily improving during the last 3 years and the quality of the plates being produced is generally very good.

Several challenges currently exist for the program. Broadly the committee sees these breaking down into the following areas:

- Effort within the ALD Group. Most production work is performed by a single person and the amount of work to be done exceeds what a single person can efficiently do. This not only slows progress, it precludes attention to the important area of developing and understanding better materials for coating MCPs.
- Cleanliness issues throughout the flow of MCPs from capillary area fabrication through handling during testing. Residual contamination from finishing of the capillary arrays as well as dust and contamination accumulated during handling at Argonne are affecting the quality of the final product. This has resulted in the need for extra cleaning before testing and degradation in performance, e.g. hotspots on the plates.
- Detailed understanding of ALD/MCP properties. “Chemistry 1”’s long term performance as well as that of MgO and Alumina needs to be studied. Understanding the effects of annealing as well as developing a best set of annealing procedures is required.

- Availability of MCPs. With the prospect of routine production of 8” MCPs within sight, the inventory of ALD-ready plates may rapidly dwindle. Making sure there is a steady flow of plates from Incom and from the electroding process will be important.

2. Specific Recommendations

In the previous section, the committee summarized the broad areas where challenges exist at present. In this section, specific recommendations are provided.

Effort Recommendations related to increased effort on the ALD process

- It is recommended that a postdoc be hired for the ALD group to specifically work on ALD of MCPs.
- The possibility of attracting a long-term Ph.D. graduate student to the projection should be investigated. Study of properties and materials development for ALD of MCPs could certainly form the basis for a thesis.
- A member of the Argonne LAPPD group should visit SSL for cross-training. This should occur at a mutually beneficial time in the future and not immediately given the present pressure to produce a sealed working tile at SSL.

Cleanliness Recommendations related to cleanliness issues with the MCPs:

- While an MCP database exists, a more detailed tracking of MCP plates from production at Incom through testing at Argonne and SSL needs to be made. This should include inspection and documentation at each stage of the (visual) quality of the plates. This will help to pinpoint operations that are contributing to contamination on the plates. In particular, an effort should be made to track the origin of the “cloudy” patches that have been found on recent plates
- Following up on the previous recommendation, a plan for mitigation of plate exposure to dust should be made. It is important that the plates stay clean through the entire flow process of the plates. This would include written procedures for handling at each step of processing.
- Again with regard to cleanliness, it is recommended that members of the collaboration in the Chicago area take the hands-on clean room training available through the Argonne Center for Nanoscale Materials.
- We support the ALD group’s efforts to develop a dedicated ALD facility with most tools in one clean place.

MCP Properties Recommendations related to detailed understanding of MCP properties

- The resistance changes observed in plates operated in the Demountable should be understood. This should include confirmation of the change and attempting to understand the mechanism. The C-5 bare glass that is used in producing the microcapillary arrays should be test for resistance change upon heating. It was noted that in the Demountable, the bottom plate exhibited a larger resistance change. Reversing the bias direction on the Demountable might be a good way to determine if the same behavior is seen when the top plate becomes the second gain stage. Testing at SSL of ALD vs non-ALD 33mm substrates should continue.
- The difference in resistivity between ALD over and ALD under electroding should be studied.
- The effect of MgO on the underlayer resistivity should be studied and understood. SIMS depth profiling may be useful.
- Life testing of Chemistry-1 MCPs should be done similar to that performed on Chemistry-2 MCPs. This would include plates with both Al_2O_3 and MgO secondary emissive coatings.
- There should be exploration of facilities to study the effects of annealing. One of the committee members (Smedley) noted that BNL has a facility to study physical/chemical changes of material during a baking process.
- A comparison of any difference between annealing *in situ* in the Beneq and annealing after exposure to air should be done.
- Discussion should happen with Ani Sumant at the Argonne CNM regarding use of ultra-nanocrystalline diamond as a possible SEE layer.
- It may be useful to investigate tools for measuring, on large scale, pore size variation in the plates.

Availability of MCPs Recommendations related to assuring a continuous supply of MCPs

- An inventory of the production and usage rate of MCPs should be made to make sure the program will have enough for future needs.
- We suggest Incom make available “sample” quality plates if possible for ALD development.

Next Meeting The committee suggests having another Godparent Review in early October, 2013.