Miasma

Hans Jostlein June 11, 2010

Abstract

The Liquid Argon Purity Demonstration (LAPD) project is being carried out to show (or disprove) that sufficient purity can be achieved in a liquid Argon fill in a vessel that has been purged with Argon gas, but not evacuated, to allow long electron drift distances with acceptable electron losses.

Phase 1 of LAPD aims to meet the goal mentioned above.

Phase 2 will introduce typical TPC construction materials into the LAPD tank and aims to reach acceptable purity levels again, using the same process.

Phase 3 is not yet firmly defined, but may include a working TPC, may use a different cryostat design, and may be exposed to particles.

We show here that the Phase 2 goals can be achieved at the conclusion of Phase 1 without warming up, and without interrupting the measurements. The proposed implementation follows an idea (that I wish I had had) by Cary Kendziora.

With a very small investment (2 valves and a diffuser assembly) we can prepare now to carry out the LAPD Phase 2 investigations directly after Phase 1 is completed. It will not require a warm-up and purge process, saving time and the cost of Argon.

Miasma Goal

The goal of Miasma is similar to that of the Material Test Station at PAB, but without the capability of testing materials while immersed in liquid Argon, or while cooled in the vapor space.

All the materials tested so far have had no adverse effect on electron lifetime if they were in the liquid. The same is true if the materials were cooled to 170 K or below in the vapor space. This behavior is consistent with the interpretation that the most common lifetime limitation is due to water. Water has a very low vapor pressure below 170 K.

Concept

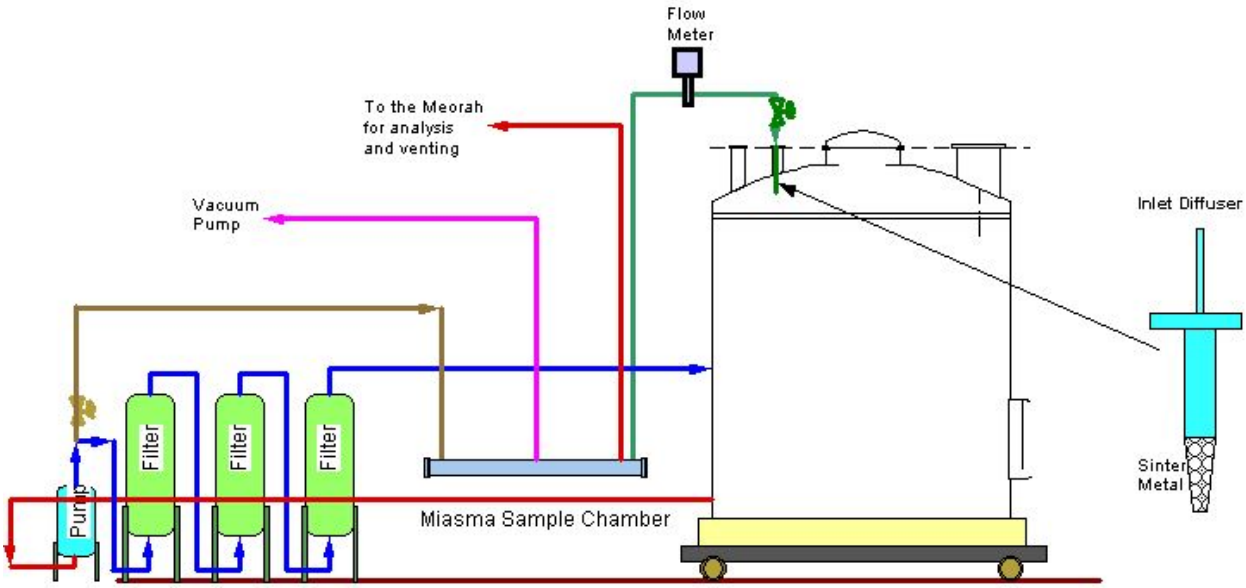
The goal can be reduced to the statement that we wish to introduce the outgassing products of the material under test into the vapor space of the LAPD cryostat. Stated this way we (i.e. CK) realized that the sample volume need not be inside the LAPD tank; it can be in an exterior sample chamber that is continuously purged by a small flow of pure gas (from LAPD) and returns the loaded flow into the LAPD vapor space.

Once this scheme is adopted, it lends itself naturally to allow specified pre-treatment of the material under test (purge, vacuum, heating etc).

The chamber can also be pre-loaded with a specific contaminants, e.g. water in Argon, or oxygen in Argon, to study effects and recovery under upset conditions.

The sample chamber also allows to do "zero-tests" and allows to change samples out at any time without interrupting the LAPD program.

Lastly, the chamber can be built and added later, provided the purge gas and re-entry point into the tank are prepared , with shutoff-valves and flanges for the future connection.



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Details

Terry Tope is already providing taps at the high pressure side of the circulation pump for gas analysis. The same taps can be used to provide the purge gas to the Miasma chamber.

The gas return into the cryostat should simulate the gas emanation from warm materials in the argon gas space of the tank. To this end, the gas return pipe with have a sinter metal diffuser to deliver the gas at low velocity, and to the top of the tank dome.

Minimum Investment

We need to prepare the system for the eventual installation of a Miasma sample chamber. The taps from the pump discharge end are already planned. The discharge diffuser needs to be prepared and installed, and terminated by a warm gas valve similar to the ones used in the Menorah.

Everything else can be prepared as time permits.

Summary

With a very small investment (2 valves and a diffuser assembly) we can prepare to carry out the LAPD Phase 2 investigations directly after Phase 1 is completed. It will not require a warm-up and purge process, saving time and the cost of Argon.