A Comparison of Outgassing Measurements for Three Vacuum Chamber Materials

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Abstract:

Jefferson Laboratory operates a nuclear physics accelerator delivering polarized electron beams with energies up to 6 GeV to three experimental halls. The polarized electrons are produced from photoemission cathodes in 100 kV electron guns. The vacuum requirements for these guns are very demanding, since the photocathode lifetime is limited by ion backbombardment from the ionization of the residual gas in the cathode-anode gap.

In order to understand the limitations of the existing gun vacuum chamber, and examine possible new chamber materials, we have undertaken a study of the outgassing rate for chambers of three different materials: 304 stainless steel (the present chamber material), 316L stainless steel, and aluminum.

Outgassing rates for each chamber were measured using two independent techniques. For one technique, the test chamber is separated from a vacuum pump by a well-defined conductance-limiting aperture. The outgassing rate of the test chamber can be determined by measuring the pressure drop across the orifice. The other technique measures the rate of rise of vacuum pressure within the test chamber using a spinning rotor gauge over an extended period of time. After experimenting with a variety of vacuum gauges, procedures and chamber configurations, good agreement was obtained between the two techniques. Outgassing rates for each material will be presented and details of the measurements will be described.

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