AEC-NASA TECH BRIEF

Performance of Low-Pressure Thermionic Converters Is Evaluated

A report describing a series of experiments to evaluate the performance of low-pressure thermionic converters has been published. The results of the investigation should help in the selection of favorable conditions for the design of thermionic reactor fuel elements, including rf output, if desired, for special applications.

The experiments with a low-pressure thermionic converter were conducted with cesium, potassium, and sodium-metal vapors. These metals provided for the neutralization of the electron space charge and the reduction of the collector work function. Although cesium is usually used as an ion producer, the results for potassium were very good. Even sodium vapor produced a relatively high power output, though less than cesium and potassium. Since the work functions of potassium and sodium are higher than that of cesium, they would permit a higher collector temperature without excessive electron back emission, a factor of importance for space application where heat rejection becomes a major problem.

A tantalum emitter was brought to the desired temperature by electron bombardment. A molybdenum collector and guard ring were situated opposite the collector. The emitter–collector distance could be varied several millimeters by means of a micrometer control. Although most experiments were limited to low pressures of 10^{-5} to 10^{-2} mm Hg, some results were obtained at pressures up to 1 mm Hg. The high-pressure data included ignited modes.

The investigation included the dc electron current, output voltage, and power as a function of emitter temperature, vapor pressure, emitter–collector distance, and effect of the different alkali metals. Covered in the investigation was the production of high-frequency oscillations (rf). The frequency, rms voltage, and power output were reported in detail as functions of the dc collector voltage, emitter temperature, emitter–collector distance, vapor pressure, and alkali metal. In addition, a dc–rf interaction was observed and analyzed. For this purpose, the rf and dc sections were separated by capacitance–inductance networks. Photos from an oscilloscope showed the amplitudes and wave shapes of the rf output.

The results were also discussed in relation to their applications for the design of thermionic reactor fuel elements. Special consideration was given to the relative merits of different alkali metals for neutralization of the space charge and reduction of the collector work function.

Notes:

1. The report is published in "Experimental Investigation of Low-Pressure Alkali-Metal Thermionic Converters for DC and RF Power," ANL-7377; Argonne National Laboratory, September 1967. This report is available from the Clearinghouse for Federal Scientific and Technical Information, Springfield, Va. 22151; price: $3.00 (microfiche $0.65).
2. This information may be of interest to persons and organizations concerned with the design and development of thermionic converters.

(continued overleaf)

3. Inquiries concerning this report may be directed to:

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Patent status:

Inquiries about obtaining rights for commercial use of this innovation may be made to:

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