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NASA TECH BRIEF

High-Temperature, Gas-Filled Ceramic Rectifiers, Thyratrons, and Voltage-Reference Tubes

The technology has been developed to permit construction of high-power, noble-gas-filled tubes designed to have the capability of operating at 800°C in a radiation environment of 20,000 hour total dose values of 10^{15} fast neutrons/cm^2 and 10^9 rads of carbon based gammas. Based on this technology, a thyratron capable of being operated as a rectifier and a voltage-reference tube was constructed and tested for 1000 hours at temperatures to 800°C. The thyratron operated at current levels as high as 15 amps and peak voltages of 2000 volts. The operating frequency was nominally 3200 cps, however, the tube was successfully operated at frequencies as high as 6000 cps. The tube dc recovery times were 8 μsec at 1 amp and 15 μsec at 15 amps. In spite of the rugged operating environment, the tube efficiency was found to be >97%.

The designs of the thyratron and diode tubes utilized a high-purity alumina ceramic envelope. The ceramic seals were fabricated by using high-temperature metallizing and palladium-cobalt brazing alloy, and have operated for over 1200 hours at 800°C. Both the grid and anode were fabricated from graphite to minimize gas clean-up due to sputtering and to minimize grid and anode emission. The cathode is a barium-oxide type emitter, approximately 70 cm^2 in area and designed such that the heater is external to the tube. Gas fill is 100 microns of xenon.

Endurance tests were conducted under varying conditions of voltage, current and frequency in the temperature range of 750 to 800°C. One tube was operated at 15 amps average current, 150 volts, 60 cycles for over 1200 hours at 800°C. Tests for up to 375 hours were conducted at 2000 volts peak inverse voltage, 2.5 amps average, and 3200 cycles per second.

Investigations were made and endurance tests run on neon-filled-regulator tubes at temperatures to 800°C. The normal running voltage for this design was 125 volts with less than a 4-percent variation over the range of 25 to 75 milliamps. The regulation, $\Delta V/\Delta I$, was found to be 0.08 volts per milliamp over this current range. It was also found that the regulation was less at 800°C than at lower temperatures. Endurance tests were run to 1500 hours at a nominal 50-milliamp current.

Notes:

1. Additional documentation is available from:
   Clearinghouse for Federal Scientific and Technical Information
   Springfield, Virginia 22151
   Price $3.00
   Reference: TSP69-10376
2. Technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B69-10376

Patent status:

No patent action is contemplated by NASA.

Source: E. A. Baum of General Electric Company under contract to Lewis Research Center (LEW-90271)

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