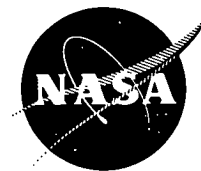


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NASA TECH BRIEF

Lewis Research Center



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A New High Temperature Noble Metal Thermocouple Pairing

Combustor research and development for advanced aircraft engines is continuously pushing towards operating temperatures and pressures higher than those found in present military and commercial jet engines. This research and development requires thermocouples that will serve in combustor gas streams at temperatures above 1873 K (2912°F) and at pressures above 20×10^5 N/m² (20 atmospheres).

The commonly used Pt-13Rh/Pt thermocouple is limited to temperatures below 1873 K (2912°F). The Ir leg of the commercially available Ir-40 Rh/Ir thermocouple is destroyed by oxidation within several minutes in gases at pressures of 20×10^5 N/m² (20 atmospheres) and temperatures approaching 1873 K (2912°F).

Screening tests for a more oxidation resistant substitute for the Ir leg of the Ir-40 Rh/Ir thermocouple showed Pt-40 Rh thermocouple wire to form a reasonably oxidation resistant thermocouple pairing composed of a positive leg wire of Ir-40 Rh and a negative leg of Pt-40 Rh. Calibration to 1673 K (2552°F) showed the thermocouple output to be nearly linear and the absolute emf to be nearly equal to that of the Ir-40 Rh/Ir pair (see figure and table).

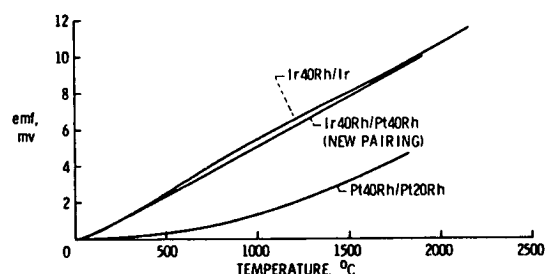


Figure 1 - Comparison of output of Ir40Rh/Pt40Rh thermocouple with originating thermocouples.

A thermocouple composed of 0.5 mm (0.02 in) wires was then subjected to the exhaust gas stream of a combustor through a pressure range of 14 to 20 N/m² (14 to 20 atmospheres) and a temperature range of 1723 to 1823 K (2642 to 2822°F) for 2½ hours. Post test examination showed only slight material loss for both alloys; the Pt-40 Rh wire reduced to 0.45 mm (0.018 in) diameter and the Ir-40 Rh wire reduced to 0.42 mm (0.017 in) diameter. Thus, the Pt-40 Rh with Ir-40 Rh pairing is suitable for future combustor work and for other similar applications.

Note:

No further documentation is available. Specific technical questions, however, may be directed to:

Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B75-10245

Patent Status:

NASA has decided not to apply for a patent.

Temperature (°C)	emf output (mv)
0	0
100	0.362
300	1.265
500	2.323
700	3.408
900	4.556
1100	5.581
1300	6.666
1500 *	7.770
1700 *	8.876
1900 *	9.992

* Extrapolated from data at lower temperatures

Table I. Calibration of Ir-40 Rh/Pt-40 Rh thermocouple.

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(LEW-12545)

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