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BIMONTHLY PROGRESS

REPORT

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On: THERMOELECTRIC MATERIALS

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THERMOELECTRIC MATERIALS

A. INTRODUCTION

This is the fifth bimonthly report concerning the effect of temperature difference on the e.m.f. in $\mu v/^{o}C$ in the molten temperature range of $Na_2O \cdot 6V_2O_5$, hereafter referred to as NV_6. Studies on NV_6 have shown it to be a promising thermoelectric material with a maximum e.m.f. of about 700 $\mu v/^{o}C$ in air. This e.m.f. is dependent on ΔT, time and atmosphere to which the hotter end of the molten NV_6 is exposed.

The variation of e.m.f. with ΔT in air, in hydrogen, in helium and in oxygen atmospheres was studied. As ΔT decreased from about 250°C to 95°C, the e.m.f. increased from about 50 to 700 $\mu v/^{o}C$, the e.m.f. tending to decrease with time. The effect of a reducing atmosphere was to reduce e.m.f./°C for the same ΔT.

It was found that ceramic (mullite) tubes cannot be used for long-time experiments due to extreme corrosion by and creep of NV_6.

The possibility of utilizing metal tubes was investigated and a relatively refined experiment involving metal tubes was conducted and is described below.

B. APPARATUS

The apparatus using stainless steel tubes was constructed as shown in Diagram 2. (See Report No. 4, 4 September 1960).

C. EXPERIMENTAL PROCEDURE

The composite tube was placed inside a 36-inch long tubular electric furnace in such a way that the lower part of the tube containing NV_6 is

in the center of the furnace where the temperature would be most uniform. Temperature gradient across the NV_6 was varied by the amount of air-cooling of the inner tube and by increasing or decreasing the furnace temperature. ΔT was measured by thermocouple T_1 and T_2 and e.m.f. by e_1 and e_2 leads connected across a Honeywell Brown recorder.

The e.m.f. was measured with air, helium, and oxygen atmospheres at the hotter end of the NV_6 for various temperature gradients across the NV_6.

D. RESULTS

The variation of e.m.f. in m.v. with ΔT for various atmospheres was found to be as follows:

1. NV_6 in air atmosphere

$\Delta T(^{\circ}C)$	e.m.f. (m.v.)
100-60	8-4

2. NV_6 in He atmosphere

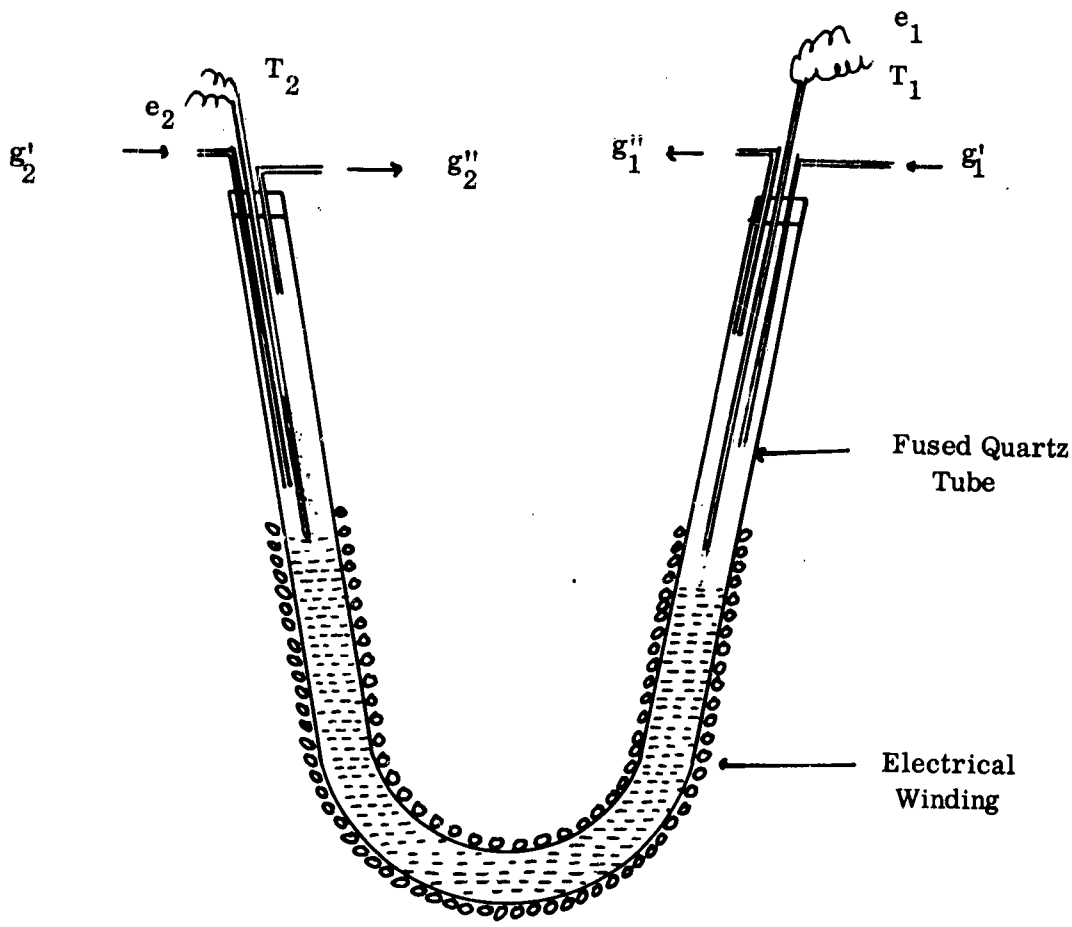
$\Delta T(^{\circ}C)$	e.m.f. (m.v.)
$\simeq 100$	$\simeq 4$

3. NV_6 in O_2 atmosphere

$\Delta T(^{\circ}C)$	e.m.f. (m.v.)
$\simeq 100$	$\simeq 3$

E. CONCLUSION

The very low e.m.f. generated and the negligible influence of the atmosphere may be due to (a) corrosion leading to oxide film and (b) corrosion leading to metal solution and/or precipitation.



T_1 and T_2 = Pt-Pt 10% Rh. Thermocouples

e_1 and e_2 = e.m.f. leads

g'_1 and g'_2 = gas inlet

g''_1 and g''_2 = gas outlet

FIGURE 1

F. FUTURE PLANS

The recent experiments have shown that fused quartz is not appreciably affected by the molten NV_6. The corrosion, diffusion and creep effects normally found with ceramic (mullite) tubes are absent. It is proposed to construct a simple U-tube apparatus using fused quartz tube as shown in Fig. 1. In this apparatus atmosphere can be provided both at the cooler end as well as hotter end of the molten NV_6. The electrical winding round the tube will provide the temperature gradient.

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