3.2 Effects of Contact Resistance on Electrical Conductivity Measurements of SiC-Based Materials — G. E. Youngblood,* E. C. Thomsen and C. H. Henager, Jr. (Pacific Northwest National Laboratory)

This is the Extended Abstract for an ICFRM-15 paper submitted for publication in the Proceedings.

A combination 2/4-probe method was used to measure electrical resistances across a pure, monolithic CVD-SiC disc sample with contact resistance at the SiC/metallic electrode interfaces. By comparison of the almost simultaneous 2/4-probe measurements, the specific contact resistance and its temperature dependence were determined for two types of electrodes (sputtered gold and porous nickel) from RT to ~700°C. The specific contact resistance values (R_c) behaved similarly for each type of metallic electrode: R_c >~1000 Ω-cm^2 at RT, decreasing continuously to ~1-10 Ω-cm^2 at 700°C (see Fig. 1). The temperature dependence of the inverse R_c indicated thermally activated electrical conduction across the SiC/metallic interface with an apparent activation energy of ~0.3 eV (see Fig. 2). For a flow channel insert in a fusion reactor blanket made with SiC/SiC composite, contact resistance could beneficially reduce the transverse electrical conductivity by ~1/2.

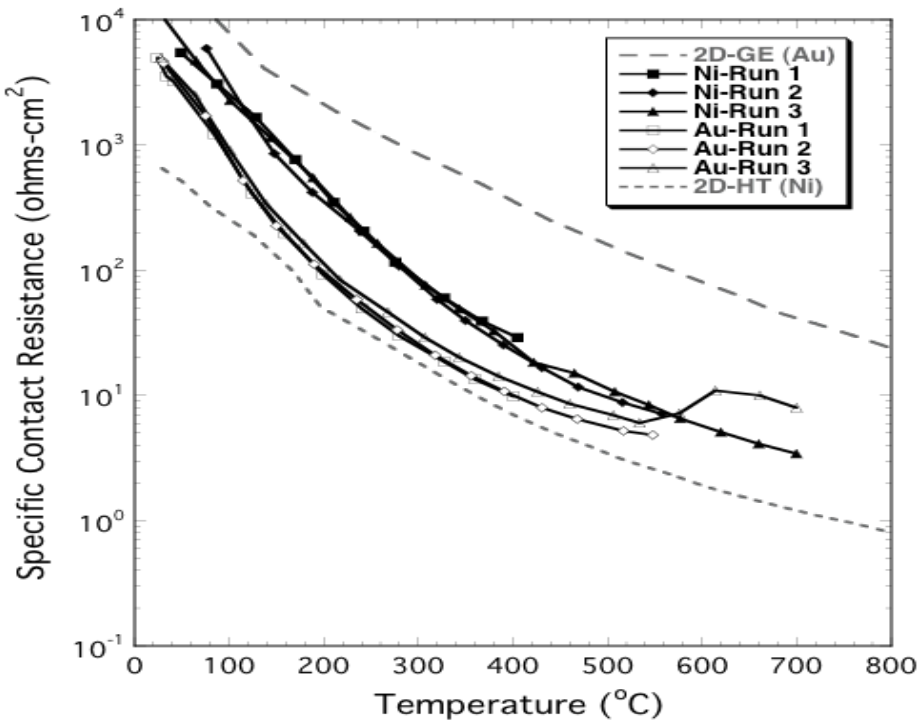

Figure 1. Specific R_c for CVD-SiC with sputtered Au or porous Ni electrodes, each during three successive heating cycles to 400, 550 and 700°C. The grey dashed lines indicate the envelope of R_c-values observed for similar sets of measurements for 2D-SiC/SiC composites with thin CVD-SiC seal coats [1].

The R_c-values determined for each set of temperature cycles to 400, 550 and 700°C were reproducible, except for the unexplained deviation from a smooth curve for the Au-Run 3 data. In general, the magnitudes and temperature dependence of the R_c-data lie between the envelope of R_c-values observed earlier for 2D-SiC_f/CVI-SiC composite disc samples with thin seal coats of CVD-SiC on which similar metal electrodes were applied [1]. The R_c-values for the porous Ni electrodes appear to exceed the values for the Au electrodes, but this may be because the actual contact area for the porous Ni electrodes is less than the geometric area of the disc sample.

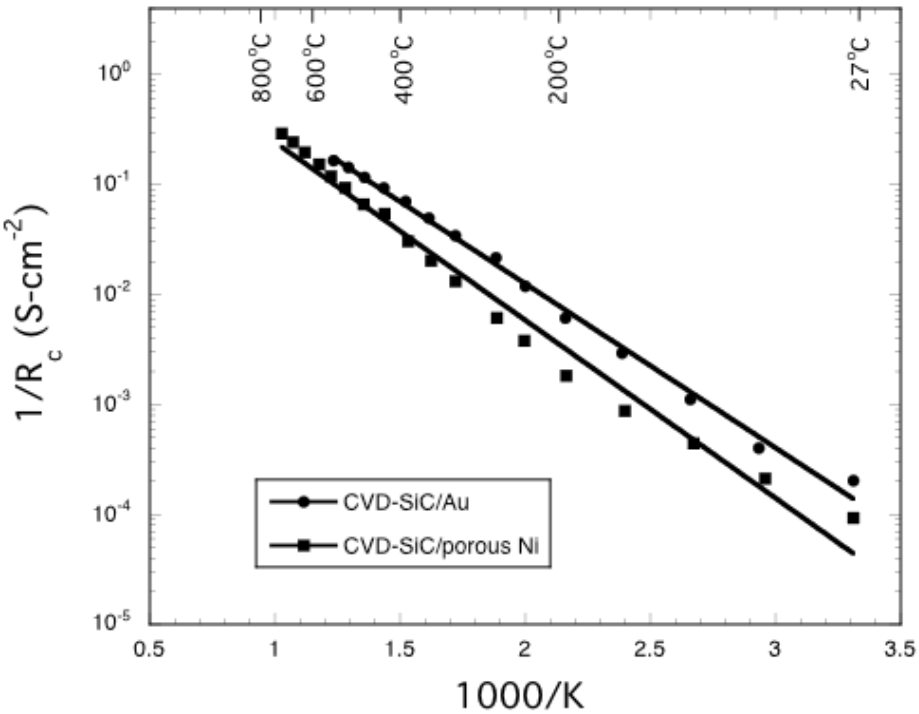

Figure 2. Inverse specific R_c for a CVD-SiC disc sample with either Au or porous Ni electrodes. Slopes of semi-log straight lines fit through the data indicate a thermal activation energy of ~0.3 eV.

The thermal activation energy of ~0.3 eV for the ~100-700°C temperature range suggests electron tunneling through a Schottky-type barrier at the semi-conductor SiC-metal electrode interface [2].

REFERENCES

[1] G. E. Youngblood, E. C. Thomsen and R. J. Shinavski, *Fus. Sci. and Tech.* **60** (2011) 364.
[2] J. Crofton, L. M. Porter and J. R. Williams, *Phys. Stat. Sol.* **(b) 202** (1997) 581.