Thermal and Electrical Properties of Diamond and Undoped Diamond Films

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The thermal conductivities of two type la and two type 1a natural diamonds and two thick undoped diamond films were measured bctwccn room t mperature and 1000°C. The two white type IIa diamonds had room temperature thermal conductivity y values of 24-25 W/cm-K which dropped to just over 4 W/cm-K at 1000°C. This is the highest known natural diamond thermal conductivity. The two yellow type Ia diamonds. which had different nitrogen concentrations, were found to have thermal conductivitics less than half of that for the type IIa diamond at room temperature and still have lower thermal conductivities (3-3.5 W/cm-K) even at 1000°C, indicating that defect impurity scattering is still important even at this high temperature. The two high purity diamond films were found to have thermal conductivities equal to to that for the natural type IIa diamonds above 400°C. The conductivities were measured parallel to the grain growth direction so grain boundary scattering would not bc expected to be very important. Additional measurements will also bc presented.

The electrical resistivity of' several natural diamonds and numerous undoped diamond films were measured between room temperature and 1000°C. The resistivities of the natural diamonds were all very similar while that of the diamond films varied by up to six orders of magnitude above 300°C, eventhough at room temperature the resistivities varied slot less. Some films were found to have a greater resistivity than natural diamond. The high temperature resistivity measurement is a very accurate method of determining the quality of a diamond film.

Kcy words: thermal conductivity, electrical resistivity, high temperatures, high purity