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# NASA TECH BRIEF

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### **Beryllium Thin Films for Resistor Applications**

Beryllium metal has a low density, a high tensile strength, a high Young's modulus, and good thermal and electrical conductivity; these characteristics make it an attractive candidate for use as an electrical conductor at very low and very high temperatures.

An investigation of the properties of beryllium wire of the size that can be used in electromagnetic actuators indicated that the manufacturing process failed to provide consistent ductility and dimensional tolerance; moreover, the commercially available wire had mechanical flaws and many occlusions. However, a thin film of beryllium was found to be highly satisfactory; this suggested applications in high-precision, high-stability resistors as well as high-power resistors.

Thin films of beryllium were prepared by an evaporation technique using electron-beam heating. By supporting target substrates above the beryllium evaporation source on a chimney, a circular target plane of about 6.5 cm was formed. Films were deposited on substrates of quartz, aluminum oxide, and beryllium oxide; a mask for the standard Hall specimen configuration was used for test samples. Electrical measurements for the films included surface resistance, resistivity, Hall coefficient, and Hall mobility.

Pure beryllium films prepared by the experimental method are not suitable for high efficiency solenoid actuator windings where the low bulk resistivity of high-purity beryllium is required, because thin films

have higher resistivity than the observed bulk resistivity. In thin films, surface boundary controlled scattering of charge carriers dominates the conduction process.

However, an experimental thin beryllium film has a very low temperature coefficient of resistance; its coefficient is approximately one third of the coefficient exhibited by the thin-film materials ordinarily used for manufacture of resistors. Beryllium thin films are particularly interesting for resistor applications because of their protective oxidation-resistant property at high temperatures and their high recrystallization temperature.

#### **Note:**

Requests for additional information may be directed to:

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