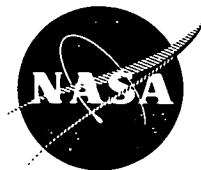


NASA TECH BRIEF

Lewis Research Center



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MAGNETOMETER USES BISMUTH-SELENIDE

Hall resistivity measurements on single crystals of bismuth-selenide show it to be an excellent material for use as a magnetometer. For any temperature between 300 and 1.2 K (80.33°F and -457.5°F), plots of Hall resistivity versus magnetic field are linear to within the experimental uncertainty of ± 1 percent in magnetic fields up to 11 Tesla. The slopes of the plots, however, vary with temperature. In addition, Hall resistivity versus magnetic field plots are independent of temperature to within 2 percent for temperatures below the liquid nitrogen boiling point (78 K) (-319.27°F).

A bismuth-selenide magnetometer has significant advantages over most other magnetometers presently in common use. Being temperature independent below 78 K (-319.27°F), the same calibration can be used for measurements in various cryogenic fluids. Copper magnetoresistors, for example, depend strongly on temperature, thus needing a magnetoresistance calibration for every temperature used. Under variable temperature conditions, this is often impractical. Bismuth-selenide magnetometers withstand thermal cycling from ambient to liquid helium temperatures, as demonstrated by repeated direct immersions in liquid helium with no changes in magnetometer calibrations.

A second significant advantage of the bismuth-selenide magnetometer is the good linearity of output versus magnetic field over a wide range of temperatures. Present Hall effect devices work well at 300 K (80.33°F) but frequently have oscillations superimposed as a function of field at low temperatures. The bismuth-selenide tested was p-type with a carrier concentration of approximately 10^{19} per cubic centimeter. Under these conditions, there are apparently no carriers with low enough effective masses to cause oscillatory effects for fields below 11 Tesla.

A third major desirable feature of bismuth-selenide magnetometers is that accurate orientation is possible due to a very flat natural cleavage plane perpendicular to the crystallographic "C" axis.

NOTE:

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

Technology Utilization Officer
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21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B72-10629

PATENT STATUS:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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