R K Pandey, Materials Science and Nanotechnology

Magnetic transistor and sensor based on Varistor diodes

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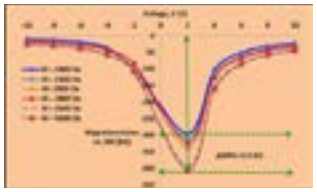
The varistor diode is typically used for circuit protection. However, its bipolar current-voltage (I-V) characteristics can be modified to produce hybrid devices having the attributes of a transistor and a magnetic sensor. The modifications are induced with the application of an electric or magnetic field. By tuning the I-V characteristics with an electric field we have produced a hybrid device that can be used either as a varistor or an electric field effect (E-FET) transistor. The paper will describe how this can be achieved using a varistor based on a ceramic IHC 45 (ilmenite-hematite ceramic) substrate. The E-FET attributes are comparable to those of a bipolar junction transistor. The high level of signal amplification and transconductance of the E-FET device exceeds the values normally found in commercially available bipolar transistors. Also the varistor itself acquires the properties of signal amplification and transconductance while still retaining its basic function of circuit protection. All these devices are particularly suitable for high temperature operations. Furthermore by tuning the voltage dependent resistance (VDR) mode of the varistor by a magnetic field one can produce magnetic sensors that can detect the magnetic field in the range of 150<H<4500 Gauss. It is rugged and suitable for hostile field operations.



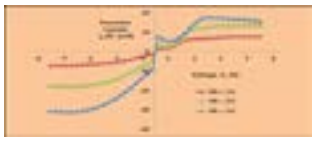


Figure 1: I-V characteristics of a ceramic based voltage-biased transistor (VBT) with varying bias voltage, V_b.

Figure 2: Magneto-resistance vs. voltage of a VDR device with varying magnetic fields.

Biography

R K Pandey is currently a Professor of Ingram School of Engineering at Texas State University, San Marcos, TX. There until two years ago he was the inaugural holder of the endowed Ingram Professorship. Before joining at TSU in 2008 he served at Texas A&M University, College Station, TX for 20 years (1977-97) and at the University of Alabama, Tuscaloosa, AL for another 10 years (1997-2007). He is a Professor Emeritus of both these universities. He is a researcher of international stature with recognized contributions in Electroceramics, high temperature superconductivity and magnetism. In the last five years, he has pioneered the fields of "Varistor-transistor hybrid devices" and "Varistor dependent magnetic sensors." He is the lead inventor for 10 US patents. He has published extensively in national and international scientific journals, has travelled abroad for presenting invited lectures and seminars and has received multiple teaching and research awards.

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