Title: Varistor-Transistor Hybrid Devices (Platform Technology/Multiple Applications)

Invention Description: This invention from researchers at Texas State University deals with unique properties and applications of their “Varistor-Transistor Hybrid Devices”. They identify a number of applications based on: (a) tuned varistors and (b) tuned transistors. In both these devices the output signal can be modified resulting in three types of hybrid devices: (1) voltage biased induced varistor-transistor hybrid device (Vb-VTH), (2) electric field induced varistor-transistor hybrid device (E-VTH), and (3) magnetic field induced varistor-transistor hybrid device (H-VTH). In certain modes they can be used as: (i) low pass filters covering a wide range of bandwidth including the human auditory range, (ii) bipolar signal amplifiers, (iii) varistors to protect the electronic circuit and ICs from abrupt input surges, (iv) transistors to meet the needs of large number of applications in microelectronics, space electronics, radhard electronics and possibly in automobile and bio-electronics. They can be used either as current amplifiers or voltage amplifiers, and (v) sensors.

Background: The invention utilizes the unique physical properties of a class of wide bandgap oxide semiconductors in the family of iron titanates; specifically, the pseudobrookite (PsB) with the chemical composition Fe2TiO5, and a solid solution comprised of ilmenite (FeTiO3) and hematite (Fe2O3) commonly abbreviated as IH and with the general formula: (1-x)FeTiO3.xFe2O3. In this invention x=0.45, so the ilmenite-hematite ceramic (IHC) of this invention (known as IHC45) has the following composition: 0.55 FeTiO3.0.45 Fe2O3. IHC45 is an n-type semiconductor and also ferromagnetic and remains so until a temperature of 610 F is attained. PsB is also an n-type semiconductor but nonmagnetic. Both IHC45 and PsB are well established radhard materials also.

The configurations for the development of the hybrid devices are simple and straightforward. They can be produced in large volumes rather inexpensively. Ceramic substrates can be used for the production of these hybrid devices giving this technology an advantage over the currently used technology in electronics.

For the development of the three types of devices the ceramic form of IHC45 and PsB were processed. Also single crystals of PsB were grown in lab and they too were evaluated for the fabrications of these devices and their applications. They details are covered in the patent application as well as in 4 recent papers (1 published, 1 in press, 1 in review and the other is in the process of being submitted to a journal).

Market Applications: This platform technology can address multiple applications including but not limited to:
- Bioelectronics (such as hearing aids)
- Cell phones, MP3’s, Radio’s, Space electronics
- High altitude electronics
- Microelectronics
- Bipolar signal amplifiers
• Electronic and audio amplifiers
• Electronic switches
• Tunable devices for low frequencies
• Non-conservative low pass filters
• Tunable transistors
• Magneto-electronics
• Magnetically controlled voltage and current amplifiers,
• High temperature electronics

Benefits and Advantages:
Some of the key benefits and advantages of this technology include:
• Platform technology with multiple applications
• High-radiation resistant (radhard)
• Anticipated lower manufacturing costs
• Materials used are biocompatible
• Abundant low cost raw materials


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