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SEMINAR

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A research on low temperature sintered ZnO varistors

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The resistance value of zinc oxide varistors can be switched at high speed between high resistance state and low resistance state with external voltage. The zinc oxide varistors has important applications to protection of electronic devices. There was a constraint relationship between low-temperature sintering of zinc oxide ceramics and low voltage gradient, which poses a huge challenge for the research of preparing low-voltage multilayer ceramics varistors under low-temperature conditions. The mechanism on the low temperature grain growth of the ZnO variants with IBs and the effect on Cr2O3 additive were studied. The effects on sintering atmosphere and sintering process on the low-temperature were also researched on the ZnO-Bi2O3 based varistor ceramics. The composition and process suitable for low-temperature co-firing were raised and pure silver co-fired MLCC ZnO chips were obtained.

Humidity/gas sensors based on ferroelectric materials

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With the arrival of the Internet of Things and artificial intelligence, humidity sensors monitoring water emissions from human metabolism have attracted great attention in the fields of smart wearable devices and noncontact human-machine interaction. However, their application is seriously limited by the trade-off between the sensitivity and response speed for traditional humidity sensors. Herein, to overcome it, high performance humidity sensors are developed based on the electric-poled $BiFeO_3$ (BFO) and $Na_{0.5}Bi_{0.5}TiO_3$ (NBT) ferroelectric material. The synergistic effect of ferroelectric polarization and oxygen vacancy provides a strong driving force and active adsorption sites for abundant of OH^-/H_2O adsorption on BFO, resulting in ultrahigh response and ultrafast response/recovery speed. Furthermore, the ferroelectric polarization induces a structural transformation in NBT to the polar R_3c phase. The response exhibits an almost linear increase, while the response time linearly decreases with the applied poling electric field, along with the proportion of the R_3c phase. Benefiting from its promising advantages, the wearable humidity sensor can accurately record the respiration rate/depth and recognize different human respiratory behaviours in real-time. Importantly, by utilizing the moisture from mouth-blowing and skin, the sensors are successfully applied to noncontact control of the robotic car, noncontact switch and noncontact interface for visualization applications. This work provides an effective strategy for developing excellent humidity sensors that meet the requirement of noncontact interaction for next-generation intelligent electronics.

Novel ultrahigh-performance ZnO-Cr_2O_3-based varistor

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The nonlinear response of a material to an external stimulus is vital in fundamental science and technical applications. The power-law current-voltage relationship of varistor is one such example. An excellent example of such behaviour is the power-law current-voltage relationship exhibited by Bi_2O_3-doped ZnO varistor ceramics, which are the cornerstone of commercial varistor materials for overvoltage protection. Here we report on a sustainable, ZnO-based varistor ceramic, without the volatile Bi2O3, that is based on Cr_2O_3 as the varistor former and oxides of Ca, Co and Sb as the performance enhancers. The material has an ultrahigh E_b up to 219, a low IL of less than 0.2 μA/cm2, and a high Eb up to 925 V/mm, making it superior to state-of-the-art varistor ceramics. The results provide insights into the design of materials with specific characteristics by tailoring states at the grain boundaries. The discovery of this ZnO-Cr_2O_3-type varistor ceramic represents major breakthrough in the field of varistors for overvoltage protection and could drastically affect the world market for overvoltage protection.

Kindly invited.