Dynamic mechanical thermal analysis and dielectric thermal analysis of siloxane rubber-based composites filled with carbon black

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ABSTRACT

Siloxane rubber-based composites filled with furnace carbon black N 220 at various concentrations were investigated by dynamic mechanical thermal analysis and dielectric thermal analysis. It was found that in the temperature interval from −30°C to 100°C the increase in the amount of carbon black results in the increase in the storage modulus (E’) values, as well as those of the mechanical loss angle tangent (tan δ). The decrease in E’ and the increase in tan δ in the interval from −40°C to −30°C was due to the process of the melting of the crystal structure of the siloxane rubber, formed during the cooling of the tested samples. Dielectric thermal analysis showed that the increase in the amount of carbon black lead to obtaining of vulcanizates with higher dielectric permittivity (ε’), whose values decrease with the increase of frequency. The research that was carried out showed that with the siloxane rubber-based composites the percolation threshold was reached when the concentration of carbon black was 20 wt%.
Pressure Sensors Based on Polyvinyl Chloride/Graphite/Nickel Nanocomposites

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ABSTRACT

The composites based on polyvinyl chloride polymer matrix filled with foliated graphite/nickel nanoparticles with remarkable and reliable pressure sensitivity was successfully fabricated. The microstructure of the nanocomposites was characterized by means of scanning electron microscopy. The effect of graphite/nickel content on the thermal stability of polyvinyl chloride/graphite/nickel nanocomposites was studied via thermal gravimetric analysis. Thermal conductivity and glass transition temperature were evaluated as a function of graphite/nickel content also. The resistivity dependence on applied pressure was tested. It was found that the polyvinyl chloride/graphite/nickel nanocomposites display a high sensitivity to pressure with good repeatability. The nanocomposites obtained may be used as pressure sensors.
Synthesis of ultrafine β-Ga2O3 nanopowder via hydrothermal approach: A strong UV “excimer-like” emission

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ABSTRACT

Interest in nano-oxides has emerged from their technological applications in fields like microelectronics, catalysis, coatings, energy storage, and environment protection and remediation. There are various available methods for preparation and production of materials, but developing new routes to nanocrystalline materials is a challenging task for materials scientists. An innovative newly developed pathway to the synthesis of gallium oxide nanopowders, so-called “high-productivity/high-yield” process is presented here. The utilized method is simple, fast and environmental friendly. Ultrafine nanopowders of gallium oxide is prepared by addition of hydrogen peroxide (H2O2) to metal gallium (Ga) via a hydrothermal route at a low temperature (100°C) and without any surfactant. β-Ga2O3 nanopowders are achieved directly in an autoclave when the initial molar ratio of Ga to O is 1:4. Combination of X-ray diffraction (XRD) and fluorescence analysis are employed to characterize the resulting nanopowders. Detailed results are discussed.
Structural and elastic properties of eutectic Sn–Cu lead-free solder alloy containing small amount of Ag and In

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ABSTRACT

Sn–Cu alloys have been considered as a candidate for high temperature lead-free microelectronic solders. In the present study, the change in microstructure, attenuation and elastic behavior associated with alloying of Ag and/or In into the eutectic Sn–Cu solder alloy system have been evaluated. The study involved measurements of longitudinal and shear wave velocities, attenuation, hardness, bulk and shear moduli, Young's and Poisson's ratio. The results of attenuation show that a clear attenuating effect in the ternary Sn–Cu–Ag and Sn–Cu–In alloys is realized, whereas the quaternary Sn–Cu–Ag–In solder displays an obscure attenuating effect. The obscure effect is mainly attributed to the competition for In between Sn and Ag, which results in weak interface formed between intermetallic compounds (IMCs) and β-Sn matrix. Likewise, Poisson's ratio results indicate that its value decreases with increasing the elastic moduli and ultrasonic velocities of Ag and In-containing alloys. The analyzed enhanced ductility of Sn–0.7Cu and Sn–0.7Cu–2In alloys and brittleness of Sn–0.7Cu–2Ag and Sn–0.7Cu–2Ag–2In alloys were rationalized on the basis of Poisson's ratio and the quotient of shear modulus to bulk modulus (Pugh's ratio). Microstructural analysis revealed that the origin of change in the elastic properties of the ternary and quaternary alloys is ascribed to smaller β-Sn dendrite grain dimensions and formation of new IMCs in the ternary and quaternary alloys.
Synthesis and physical properties of mixed Co 3O 4/CoO nanorods by microwave hydrothermal technique

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ABSTRACT

A mixture of crystalline Co3O4/CoO nanorods with non-uniform dense distribution has been successfully synthesized by microwave hydrothermal technique. The synthesized nanorods have been characterized by several techniques such as X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), energy-dispersive X-ray spectroscopy (EDX), and Fourier transforms infrared spectroscopy (FT-IR). The results showed that the as synthesized specimens contained mixed crystalline Co3O4/CoO nanorods with an average length of around 80nm and an average diameter of 42nm. UV–Vis spectrum of the nanorods exhibited a strong UV emission. The band energy gap of the product was 1.79eV which lies between the energy gap of CoO and that for Co3O4. The obtained carrier concentration is of the order 4.32×1027m−3 and the dielectric constant is found to be 4.89. The electrical conductivity increases with increasing temperature and behaves as a semiconducting material with an activation energy of about 0.26eV. This makes the as synthesized mixed Co3O4/CoO nanorods very useful for supercapacitor devices application. Magnetic hysteresis loops at room temperature of the as synthesized mixed oxides (Co3O4/CoO) nanorods exhibit typical soft magnetic behavior.