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DEVELOPMENT OF HUMIDITY SENSING COMPOSITE MATERIAL USING SnO_2 DOPED PHENOL FORMALDEHYDE (PF) DERIVED CONDUCTIVE CHARCOAL

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Humidity sensors play a vital role in various industries and medical applications, necessitating the development of cost-effective sensing materials to meet the increasing demand. This study focuses on creating a low-cost sensor material derived from waste polymer materials and compares its sensing characteristics, including resistance, hysteresis, recovery and response times, and stability concerning relative humidity. By subjecting phenol formaldehyde (PF) to thermal modification at 700 °C, conductive carbon was produced. Subsequently, SnO_2 was doped via hydrothermal treatment at 140 °C. The resulting SnO_2-doped pyrolyzed carbon composite was deposited onto gold-coated resistive-type electrodes to fabricate the sensor. The composite material underwent characterization using techniques such as scanning electron microscopy (SEM), powder X-ray diffraction spectroscopy (PXRD), thermal gravimetric analysis (TGA), and Raman spectroscopy. Further, the performance of the humidity sensor was investigated. The resistance response demonstrated values of 54188.30 and 27876.50 Ω as relative humidity (RH) increased from 33% to 95%. The recovery time and response were determined to be approximately 11 s and 40 s, respectively. The humidity sensitivity of the SnO_2 charcoal composite was found to be 227.55 Ω per percentage RH, attributed to the enlarged specific surface area resulting from its unique nanostructure. These are just a few examples of applications where high-sensitivity humidity sensors are valuable. The sensitivity of the sensor directly affects its ability to detect small changes in humidity levels, making it a key factor in achieving accurate and reliable measurements in these critical domains. These findings indicate that the SnO_2 charcoal composite holds promise as an ideal material system for producing high-performance and cost-effective humidity sensors.

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Keywords: Humidity sensing, Hydrothermal reaction, Nanotechnology, Pyrolization