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Microwave Dielectric Properties and Microstructures of $Nd(Ti_{0.5}W_{0.5})O_4$ Ceramics for Application in Wireless Gas Sensors

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Abstract : Carbon monoxide is a substance produced by the incomplete combustion. It is toxic even at concentrations of less than 100ppm. Since it is colorless and odorless, it is difficult to detect. CO sensors have been developed using a variety of physical mechanisms, including semiconductor oxides, solid electrolytes, and organic semiconductors. Many works have focused on using semiconducting sensors composed of sensitive layers such as ZnO, TiO_2, and NiO with high sensitivity for gases. However, these sensors working at high temperatures increased their power consumption. On the other hand, the dielectric resonator (DR) is attractive for gas detection due to its large surface area and sensitivity for external environments. Materials that are to be employed in sensing devices must have a high-quality factor. Numerous researches into the fergusonite-type structure and related ceramic systems have explored. Extensive research into $RENbO_4$ ceramics has explored their potential application in resonators, filters, and antennas in modern communication systems, which are operated at microwave frequencies. $Nd(Ti_{0.5}W_{0.5})O_4$ ceramics were synthesized herein using the conventional mixed-oxide method. The $Nd(Ti_{0.5}W_{0.5})O_4$ ceramics were prepared using the conventional solid-state method. Dielectric constants (ε_r) of 15.4-19.4 and quality factor (Q×f) of 3,600-11,100 GHz were obtained at sintering temperatures in the range 1425-1525°C for 4 h. The dielectric properties of the $Nd(Ti_{0.5}W_{0.5})O_4$ ceramics at microwave frequencies were found to vary with the sintering temperature. For a further understanding of these microwave dielectric properties, they were analyzed by densification, X-ray diffraction (XRD), and by making microstructural observations.

Keywords : dielectric constant, dielectric resonators, sensors, quality factor
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