

ZrO₂:TiO₂复合纳米纤维湿度传感器的直、交流特性研究

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摘要:

利用复合ZrO₂:TiO₂纳米纤维制作了特性良好的电容型湿度传感器。该湿敏元件在100 Hz测量频率下灵敏度较高, 线性度较好。其电容值在11-98%相对湿度范围内从20 pF变化到1.5 × 10⁵ pF。文中从直流特性(伏安特性、极性反转瞬时性)和交流特性(复阻抗)的角度分析了该湿敏元件的感湿机理。利用瞬时直流极性反转法研究了该元件在不同湿度下参与导电的粒子类型; 通过复阻抗分析软件ZView 仿真并构建合理的等效电路, 在等效电路中引入常相位元件和Warburg阻抗分析离子、电子和偶极子在交流电场下对湿敏元件感湿过程的影响。

关键词: 复合纳米纤维; ZrO₂:TiO₂; 直流特性; 交流特性; 湿度传感器

Study on the DC and AC properties of humidity sensor based on ZrO₂:TiO₂ composite nanofibers

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Abstract:

A capacitive humidity sensor was fabricated based on ZrO₂:TiO₂ composite nanofibers. The humidity sensor exhibits high sensitivity and good linearity at 100 Hz of measurement frequency, which capacitance varied four orders of magnitude from 20 pF to 1.5 × 10⁵ pF in the humidity range of 11-98% RH. In present paper, the humidity sensing mechanisms of the sensor were discussed by analyzing dc properties (current-voltage properties and transient with reversing dc bias polarity) and ac properties (complex impedance) of the sensor. The type of carriers of the sensor at different RH was found via transient ionic current by reversing dc bias polarity. Equivalent circuits of the sensor for different humidity ranges were created based on the corresponding complex impedance plots, and which simulated by using the software ZView. Constant phase element (CPE) and Warburg impedance were introduced and used to analyze the influence of ions, electrons and dipoles in the humidity sensing process of the sensor and in alternating-current field.

Keywords: composite nanofibers; ZrO₂:TiO₂; dc properties; ac properties; humidity sensor

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