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Novel Strategy to Develop Chemical Sensors Based on Nonlinear Dynamics—Intelligent Gas Sensor

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We propose an intelligent gas sensing system based on nonlinear dynamics. A sinusoidal voltage is applied to a heater equipped with a ceramic gas sensor, and the resulting output resistance of the sensor is analyzed by fast Fourier transformation (FFT). It is shown that the higher harmonics of FFT correspond to the nonlinear property of the response. It has been found that the intensities of the higher harmonics exhibit characteristic changes depending on the chemical structure of the gases. The experimental error of this system is rather small and undesirable effects due to aging can be minimized. The nonlinear response of this system is discussed in relation to the kinetics of adsorption, chemical reaction, and desorption of gas on the ceramic surface and the temperature-dependent resistance of the semiconductor.

1. Introduction

Living organisms can maintain their lives by flexible adaptation to their variable surroundings. It is important to know the mechanism by which living organisms can perceive various stimuli through receptor cells and the processes by which their nervous systems recognize them. When the receptor cells receive external stimuli, the electrical impulses which are generated in the nervous membranes are transmitted to the nervous system. As the excitation and pulse generation in nervous cells are regarded as typical nonlinear phenomena, it may be of value to study how the "nonlinear characteristics" relate to informational transformation in living organisms.