Nanocomposite carbonaceous-palladium thin films for ammonia sensors

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Abstract. Nanostructural carbonaceous-palladium (C-Pd) films for ammonia sensing were studied. These C-Pd films were prepared in a two-step process: the first one involved physical vacuum deposition (PVD) and the second one chemical vacuum deposition (CVD). The structure and morphology of the obtained films were characterized with the use of Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM). Measurements of ammonia sensing showed that resistivity of the film changes with ammonia content in ambient atmosphere.

1. Introduction

Ammonia is one of the most common chemicals. Due to its high nitrogen content, ammonia is mainly used as a fertilizer. Ammonia also finds its industrial applications, e.g. in cleaning, refrigeration engineering, manufacturing of various chemical products, textile, and finishing. Although ammonia is so widely used it is both caustic and hazardous because of high toxicity. Ammonia gas is dangerous and harmful. Its detection makes an important issue.

There are a lot of sensors for ammonia [1], most of them based on zinc oxide as the active material [2-5] or on titanium oxide [6,7]. They have high power consumption since proper operation of sensors requires the use of heating elements. Ammonia gas is very corrosive, often resulting in a drift and short life of the sensors.

In this paper we propose to apply nanocomposite carbonaceous-palladium films for ammonia sensing. Based on our previous studies [8-11] we know that these films have a highly-developed surface and they are porous.

Specially manufactured carbonaceous-palladium films are sensitive to ammonia and do not require heating. They also demonstrate promising sensory properties for the detection of ammonia. The cost of producing a sensor based on carbonaceous-palladium films and materials for the sensors is low.

The ammonia sensing mechanism could depend on a change in the concentration of charge carriers in the C-Pd films [12,13]. Such an explanation was proposed for palladium/polypyrrole nanocomposite films [14]. Chemisorption of ammonia molecules on the surface of palladium nanograins is accompanied by a charge transfer from NH_3 to Pd, leading to the reduction in the