Gas sensing properties and structural characterization of hot-wire porous metal oxides thin films

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The suitability of a material to be used in the fabrication of chemical sensors depends on its ability to return its resistance to its initial state upon removal of the cause that induced the change of its properties. Many materials have been used up to now for the formation of chemical sensors. Among them are a lot of metal oxides like WO_3, Ta_2O_5 and MoO_3 [1, 7]. The above oxides are of great interest and have been investigated extensively owning to their promising physical and chemical properties [2-3]. Many techniques are being used for the fabrication of metal oxides thin films, including thermal evaporation [4], chemical vapor deposition [5] and sputtering [6].

The aim of our research is to examine hot-wire metal oxides (hwMO) thin films as sensory materials in chemical sensors [7] and to investigate their structural properties. These films are deposited very easily compared to other methods by a heated metallic filament under vacuum. This deposition method can be applied for all metallic oxides having higher vapor pressure than the corresponding metal. The deposited oxides are porous [8] and exhibit reversible resistance changes stimulated by their environment; render them suitable for gas sensing applications.

The resistance variations of these configurations caused by changes in their environment were monitored. Reversible changes of resistance, of the order of several KOhms and MOhms, were observed in these metal oxides films caused by the presence or upon removal of gases (H_2 and CO). The magnitude of these changes, related to the sensitivity, was found to depend on hydrogen and carbon monoxide concentration and temperature of measurement (150 ^{o}C - 450 ^{o}C). The time needed (response time) for the resistance to drop or to rise after gas exposure was found comparable to that needed to recover to its initial value after gas removal. Response times of the order of a few seconds were measured on hwMO films, much shorter than those measured on metal oxides samples deposited by other methods, like chemical vapor deposition [5].

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