OZONE SENSOR BASED ON NANOCRYSTALLINE SiC FILMS

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In recent years, scientists of the leading countries of the world have been paying more and more attention to solving global environmental problems on the planet, including air pollution and global warming. One of the factors that negatively affect these processes is the presence of ozone in ground atmosphere layers. This is the result of the widespread use of ozone in many important industrial processes, such as the purification of drinking water and soil, the disinfection of plant and animal products, tissue bleaching, the complete oxidation of by-gases in the production of various organic chemicals, the sterilization of medical supplies, etc. Especially relevant in our time that ozone can be used to destroy the new coronavirus and disinfection.

In this paper, we investigated the ability of nanocrystalline SiC films to detect ozone in an air mixture. Thin layers of nc-SiC films on leucosapphire substrates were prepared by method of direct deposition of carbon and silicon ions with an energy of 100-120 eV at the substrate temperature of 1000°C. Films deposited under these conditions contained a mixture of nanocrystals of cubic and rhombohedral polytypes. The sizes of nanocrystals varied in the range 5–50 nm. The temperature dependence of the ozone sensitivity coefficient S (O3) was studied in the temperature range 100–450°C. It was found that the maximum values of S (O3) +0.71 and -0.80 were observed at temperatures of 280°C and 330°C, respectively, for an ozone concentration of 0.1 g/m3 and 4.0 g/m^3. Moreover, S (O3) had a positive sign for a temperature of 280°C, and S (O3) was a negative value for 330°C.

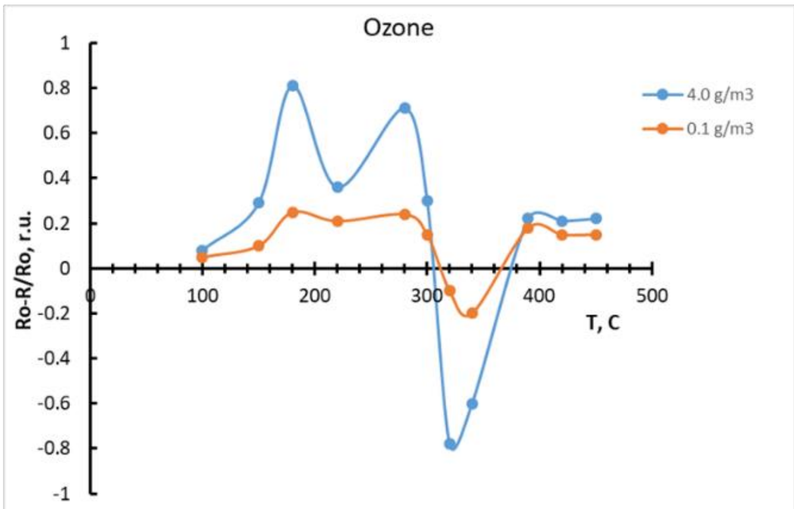

Fig. Gas sensing results of nc-SiC film towards ozone concentration of 0.1 g/m^3 and 4.0 g/m^3 versus temperature.

The different polarity of the change in the film resistance at given temperatures was due to the different ratio of redox reactions on the surface of nc-SiC films. Both temperatures can be used for detecting ozone with sensors on nc-SiC films, however, from the point of view of reducing energy consumption, 280°C should be used as the operating temperature.

Thus, highly reliable ozone sensors can be created on the basis of nanocrystalline nc-SiC layers for operation with heavy conditions.