Ecological Gas-Analysis Using a New Type Quartz Vibrating Reed

Description

Security of mankind is closely related with the monitoring of toxic and explosive gas compositions in surrounding air. It is know that at the beginning stage of fire and pyrolysis along with organiccompaunds it is always observed the exit of carbon oxide (CO) and hydrogen (H_2) gases. For their timely and selective recording it is necessary to have a simple in manufacturing and sufficiently fast sensors. On the beginning stage of fire the concentrations of carbon oxide and hydrogen gases are, correspondingly, 10-20 and 20-80 ppm. Therefore the threshold for sensors for these gases should be on level of 20 ppm at normal air conditions, but the delay time no more than 10 sec.

Innovative Aspect and Main Advantages

The Existing sensors for ecological purposes (among them electrochemical, thermocatalitical and etc.) are too expensive, but those using semiconductors have not suffcient selectivity.

The analysis of nowadays sensors has shown the perspectivity of using of quartz resonators with nanocrystal coatings composed of transition metal nanoparticles Ni, Pt and Ag types with sizes of the order of 10-15 nm for hydrogen and transition metal's oxides of SnO2 type doped by Ag with 10-30nm particle sizes for CO. Nanoparticle coatings are capable to adsorb larger amounds of molecules of different gases as compared with bulk materials due to more developed structure of their surfaces and higher chemical activity.

Areas of Application

We suggest to use as the basis the Ш – type high-quality quartz resonator of a new type developed and successfully approbed in the Andronikashvili Institute of Physics allowing one to receive a record quality up to ~106, and also the elements of reliable electronics developed there.

It will be carried out a high precision controle of vibrating reed natural frequency change at adsorbtion of investigated gas by nanoparticles in correspondence with known Sauerbrey equation.

The carried by us an assessment of its frequency change at anticipated mass change of reed on ~0,5 μg showed $\Delta f \sim 100 Hz$. This could be easily detected by this type sensor, because at the pointed quality the resonance curve width of this resonator is of the order of ~1Hz for its natural frequency ~1 MHz.

Stage of Development

We have carried out previous tests of Ni and Pt nanopowders in respect to hydrogen, and it was also elaborated the method for fabrication of Ш – type quartz resonators with optimal parameters.

The sensor of this type is very simple in manufacturing, compact and would respond to all above presented requirements in respect of sensitivity and rapidity.

The project will be realized by group of physicists-experimentators with a great experience in acoustic spectroscopy and nanotechnology fields.

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