УДК 621.38

USING MICROELECTRONIC FREQUENCY TRANSFORMERS OF TEMPERATURE

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I'd like to tell you about methods for diagnosis and control of solids during plasma-chemical treatment of semiconductor materials. These methods can be divided into direct and indirect. The aims we are trying to reach are to analyse the current state of research and developments in the field of solids temperature diagnosis in microelectronics. We also try to look for the most appropriate method and to solve the problems of temperature range extension. We will consider only those methods, that deal with solids temperature.

Measurement of inner temperature of solids by direct methods is mostly realized by placing sensor (thermotransformer) into the holes inside the body being researched. Methods of direct temperature control include methods based on different principles of temperature conversion into physical quantaties, which can be directly measured. Main requirement for the direct methods of temperature measurement is the minimal difference between the temperature of the sensor and the object temperature being measured.

Indirect methods of temperature measurement include methods built on different principles of transforming thermal emission into physical value, that can be measured directly. And, of course, thermal contact between the object of measurement and the primary temperature transformer is not necessary. Indirect methods of temperature measurement do not require the identity between the sensor and the object of measurement.

Therefore, possibilities for diagnosis and control of wafer processing thermal conditions are very wide. But works, concerning only temperature monitoring of plasma-chemical surface reactions are very few. It is explained by the fact that while studying these processes we should take into account two temperatures: plasma temperature and substrate temperature. Thus, to determine plasma temperature is very difficult. So, to simplify the task we will consider only substrate temperature. Having estimated the temperature balance of the wafer in plasma processing we determined such problems:

- first, for reliable registration of reactive thermal effects of "low temperature" range it is essential to increase the sensitivity of wafer temperature by 0,3 – 0,5 K.
- second, reactions that have high arrenius dependence between speed and low temperatures manifest exponantialy decreasing thermal effects.

These two issues make temperature determination more difficult. They also narrow the range of applicable technological processes, by which etching end can be detected. For now we have found satisfactory solution for one of the problems discussed above. We suggest to use microelectronic frequency transformers of temperature. They are made on the basis of combination of transistors, diodes and other electronic elements. And, of course, they meet our requirements.