DIELECTRIC SPECTRA OF HIGH-UP TEMPERATURE MICA-BASED INSULATORS

Ing. Martin FRK, Doctoral Degree Programme (2)
Dept. of Electrical and Electronic Technology, FEEC, BUT
E-mail: frkmar@feec.vutbr.cz

Ing. Roman KAMENÍK, Doctoral Degree Programme (2)
Dept. of Electrical and Electronic Technology, FEEC, BUT
E-mail: kamenik@feec.vutbr.cz

Supervised by Dr. Karel Liedermann

ABSTRACT

The object of this thesis is to measure and to analyse dielectric spectra of some sorts of high-up temperature materials. In this way was this material Thermikanit 26.000. Experimental investigation is realized in frequency areas. At the same time is monitoring the temperature influence on course of relaxation process. Theoretical hypothesis about behaviour of Thermikanit is explained in this paper.

1 INTRODUCTION

The subject of the studies is Thermikanit 26.000, a high-temperature mica-based insulation material used primarily for heating elements in household appliances as well as for insulation covers, supports and panels for industry used with temperatures up to 500 °C [3]. The insulation material contains according to the specification some 91 ± 1 % of uncalcinated muscovite mica paper and 9 ± 1 % of silicon binder. The material was delivered in the form of rigid sheets about 1200 x 1000 mm.

2 EXPERIMENTAL

The object of this work was investigation of temperature and frequency dependences of complex permittivity. Measurements were done with the purpose-built measuring capacitor that was designed for temperatures up to 250 °C (Fig. 1). The diameter of the guarded electrode of this capacitor was 38 mm and the width of the gap between the guarded electrode and the guard was 1 mm. Investigation of both parts of complex permittivity was carried out in the frequency range 100 Hz – 0,1 MHz. It was used precision LRC meter HP 4284, made by Hewlett Packard. The function of this instrument is based on bridge techniques with auto-calibration and its measured results are capable over the frequency range 20 Hz – 1 MHz [2].

From the sheets of Thermikanit were prepared square shaped testing samples with the sizes approximately 60 x 60 mm and nominal thickness 0,31 mm. The samples were inserted in to the electrode system that was situated in the temperature unit. It was measured capacitance and tg δ at the temperatures 50, 100, 150, 200 and 250 °C. From this values were evaluated parts of complex permittivity ε*.

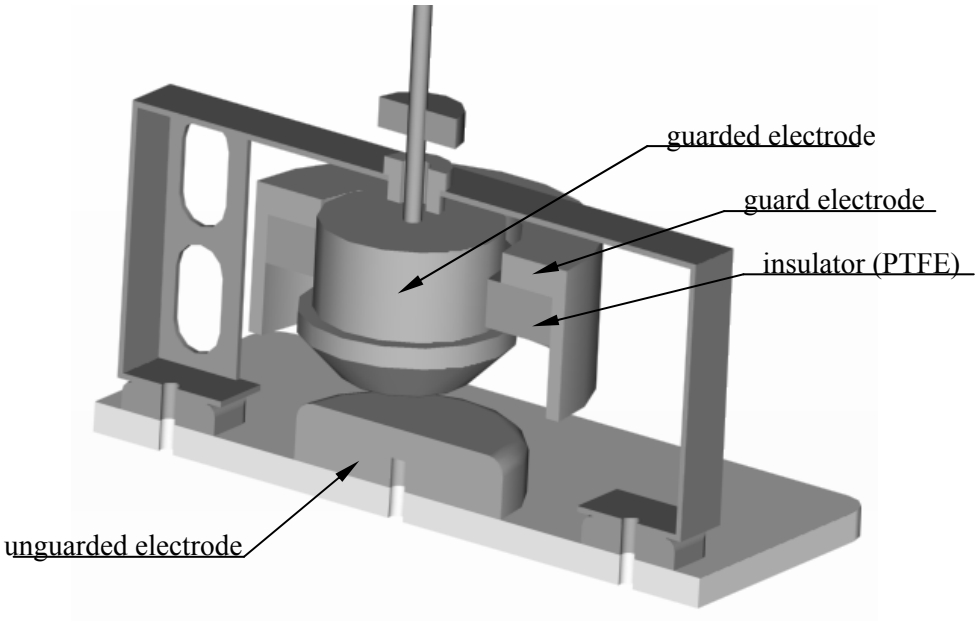

Fig. 1: *Cross-section of used special electrode system*

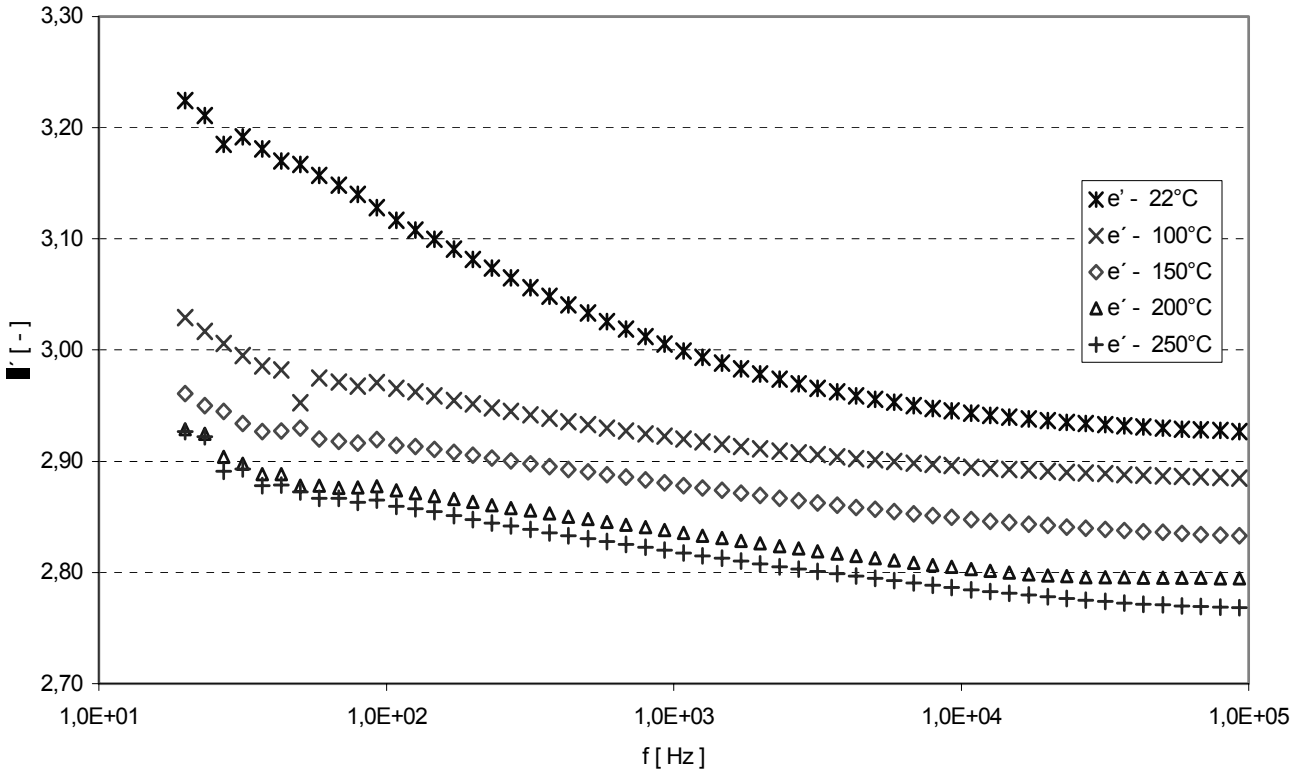

Fig. 2: *Frequency dependence of relative permittivity with the temperature as parameter*

3 RESULTS

The values of the real part of complex permittivity lie for all frequencies and temperatures within the range 2,8 – 3,2. Relative permittivity ε' exhibits a moderate decrease both with increasing frequency and with increasing temperature. The decrease of ε' with temperature may be attributed to the thermal expansion of the sample. As a matter of fact, in case of vapor-deposited electrodes no weight was applied onto the upper electrode and therefore it is possible that the sample was getting thicker and raised the conical contact tip thus increasing the sample capacitance [2].

The second exploration of relative permittivity descent is caused by presentation a small amount silicon binder in the sample because silicone are materials which with increasing temperature come to descent of course relative permittivity.

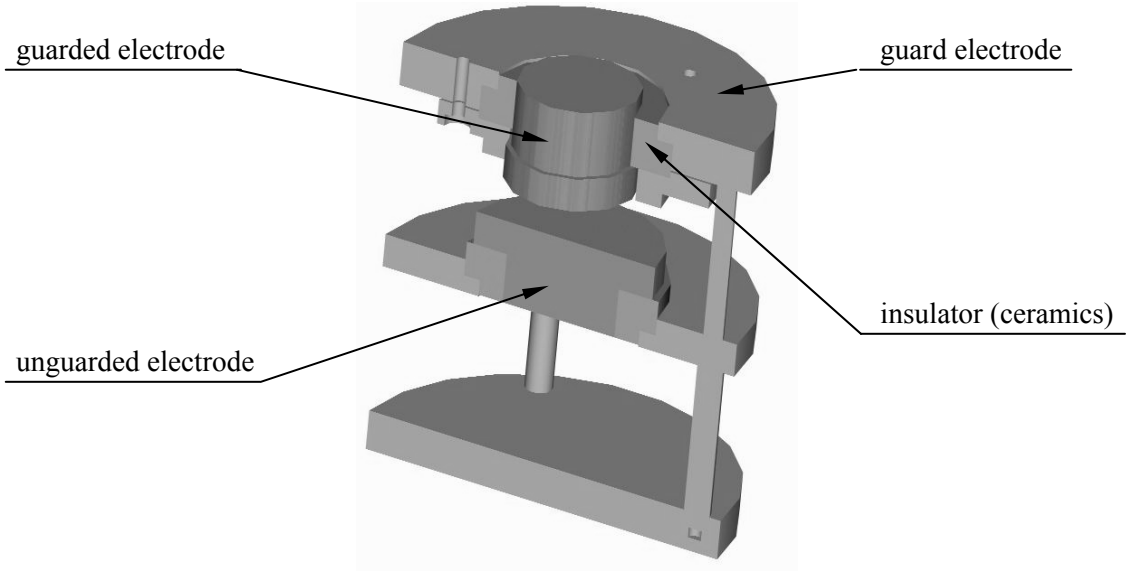

Fig. 3: *Cross-section of new electrode system*

CONCLUSION

In this time was designed and realized new measuring capacitor for temperatures up to 500 °C and frequency up to 1 MHz (Fig. 3). The diameter of the guarded electrode of this capacitor is the same as previous. Between guarded and guard electrodes is ceramics insulator now (before PTFE). This system should eliminate temperature expansion of samples.

Experimental work with the Thermikanit has been still going on and its results will be published continuously. By measuring on Thermikanit samples were following results discovered:

- Relative permittivity goes down with the higher temperatures and frequencies. The explanation of this phenomen is described in previous part.
- The object of next research on this material will be description of tg δ and ε" behaviour with temperature parameter.

ACKNOWLEDGMENT

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REFERENCES

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[2] Liedermann, K., Polsterova, H., Frk M.: Relaxation and resistance in high-temperature insulation in frequency and temperature domain. DIAGNIOSTIKA 2003, Plzen 2003.

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