Abstract—Area of Interest: Noise and fluctuations in mesoscopic and nanostructured devices (poster). The low-frequency noise in a nanometer-sized virtual memristor was investigated. The noise in the high resistive state was found to be featured by nearly the same probability density function and spectrum as the inner noise of the experimental setup. In the low resistive state, a considerably higher flicker noise $1/f^\gamma$ with $\gamma \approx 1.3$ was observed in the low-frequency band attributed to the motion of oxygen ions via oxygen vacancies in the filament. Activation energies of oxygen ions motion determined from the flicker noise spectra were distributed in the range $[0.52; 0.68]$ eV at 300 K.

Keywords—low-frequency noise; memristor; ions.

I. INTRODUCTION

A nanometer-sized virtual memristor was investigated [1]. This one consists of a contact of a conductive atomic force microscope (CAFM) probe to an yttria stabilized zirconia (YSZ) thin film deposited on a conductive substrate.

YSZ is featured by high oxygen ion mobility, thus, it is a promising material for the memristor application. The oxygen vacancy concentration can be controlled by varying the molar fraction of the stabilizing yttrium oxide.

We measured the electric current flowing through an individual conducting filament both in low resistive state (LRS) and in the high resistive state (HRS) of the memristor. It was possible due to low size of the CAFM probe contact to the YSZ film (about 10 nm in diameter).

Probability density functions (pdf) and spectra of the CAFM probe current in both LRS and HRS were measured.

The noise in the HRS was found to be featured by nearly the same pdf and spectrum as the inner noise of the experimental setup.

In the LRS, a considerably higher flicker noise $1/f^\gamma$ with $\gamma \approx 1.3$ was observed in the low-frequency band (up to 8 kHz). This noise is assumed to be attributed to the motion of oxygen ions via oxygen vacancies in the conducting filament.

Activation energies $E$ of oxygen ions motion determined from the flicker noise spectrum were distributed in the range $[0.52; 0.68]$ eV at 300 K. This range matches satisfactory with results obtained from the low temperature (300–500 K) measurements on the samples with macroscopic contacts, $E = 0.55–0.56$ eV [2].

Knowing these values is of a key importance for understanding the mechanisms of the resistive switching in the YSZ based memristor as well as for the numerical simulations of memristor devices.

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REFERENCES
