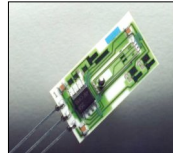


High-Voltage Sensitivity Studies of Model Thick Film Resistors

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Thick-film technology

- Additive circuit fabrication method
- Resistors printed on the substrate
- As-printed tolerance can be as large as 20-30%

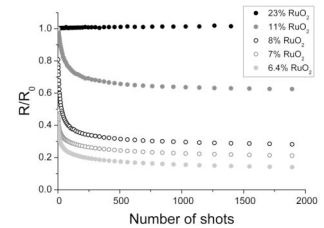


→ A trimming step is usually needed to meet the requirements for the production of reliable electronic devices.



Voltage Trimming

- High-voltage pulses induce changes in the microstructure of the thick-film resistor (TFR)
- Can be applied on buried and very small resistors
- Diminishes the sensitivity of the resistor to voltage pulses
- Low cost trimming method



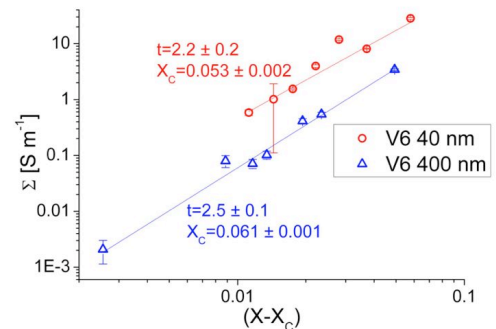
Evolution of the resistance of different samples during trimming.

R_0 is the initial value of resistance and R_T the asymptotic one after trimming

Thick-film resistors (TFRs)

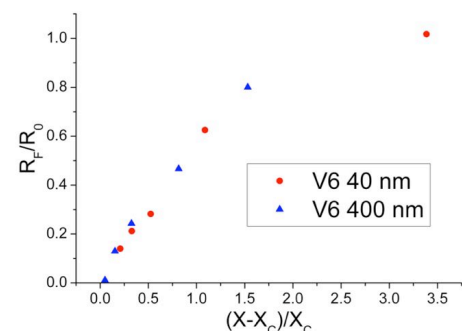
TFRs are disordered conductor-insulator compounds. We study the influence of the conducting grain size and concentration on the sensitivity to voltage pulses. The glassy grains have sizes of 1-3 μm and the conducting ones whether 40 or 400 nm. Those compounds display a conductor-insulator transition at a critical volume concentration X_c and the conductivity Σ displays a critical behavior, typical of percolating systems, near that threshold:

$$\Sigma = \Sigma_0 (X - X_c)^t$$



Sensitivity to Trimming (TS): Influence of size and Conductor Concentration

The conducting grain size was thought to be important for the sensitivity of the resistor to voltage pulses. It is shown here that this influence was in fact due to the lowering of the critical concentration X_c with the grain size. If we compare the TS of samples with the same relative distance to X_c we see no influence of the grain size. On the other hand the TS is very sensitive to the concentration relative to X_c showing that it is the topology of the underlying percolation network that is most important for the sensitivity to voltage pulses.



Sensitivity to Trimming (TS): Influence of the firing temperature

The firing temperature is also a parameter of importance for the TS. As shown here the sensitivity of a sample to voltage pulses decreases with increasing firing temperature. This result supports the assumption that a resistance change will be observed only if the temperature in the resistor locally exceeds the maximum temperature reached during firing.

