

Features of humidity-sensitive thick films based on nanoporous ceramics



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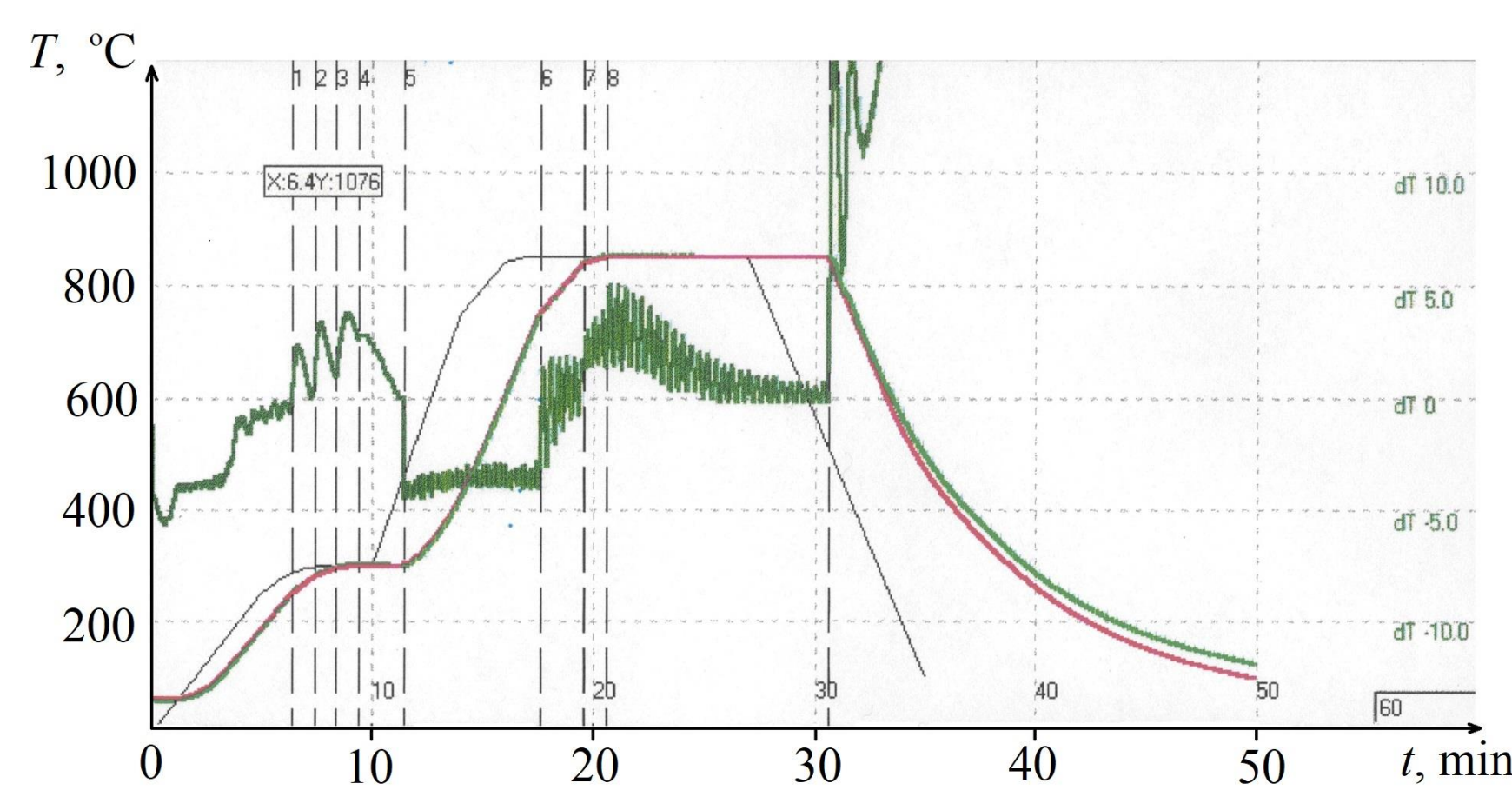
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Humidity-sensitive thick films based on MgAl₂O₄ ceramics



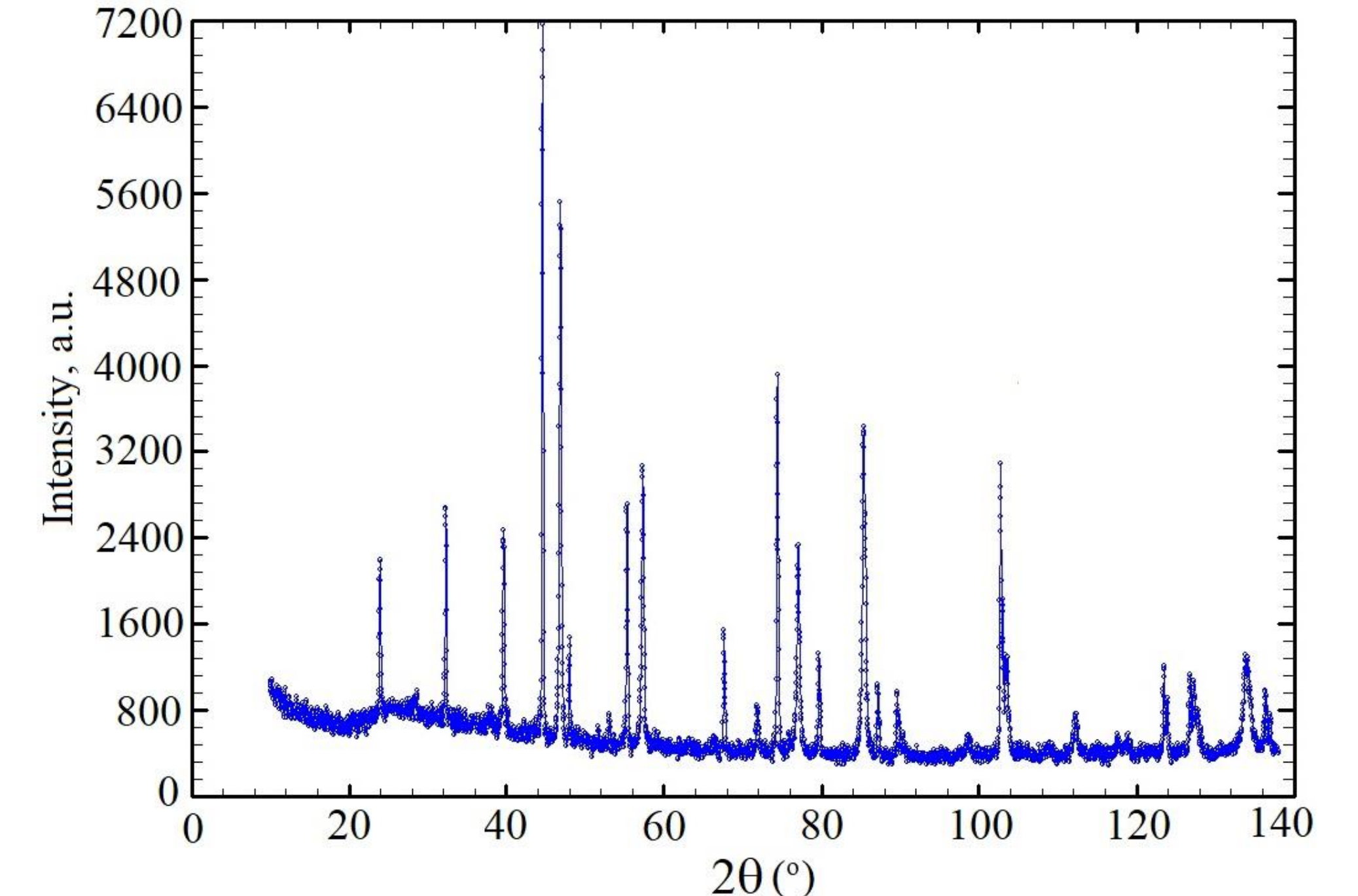
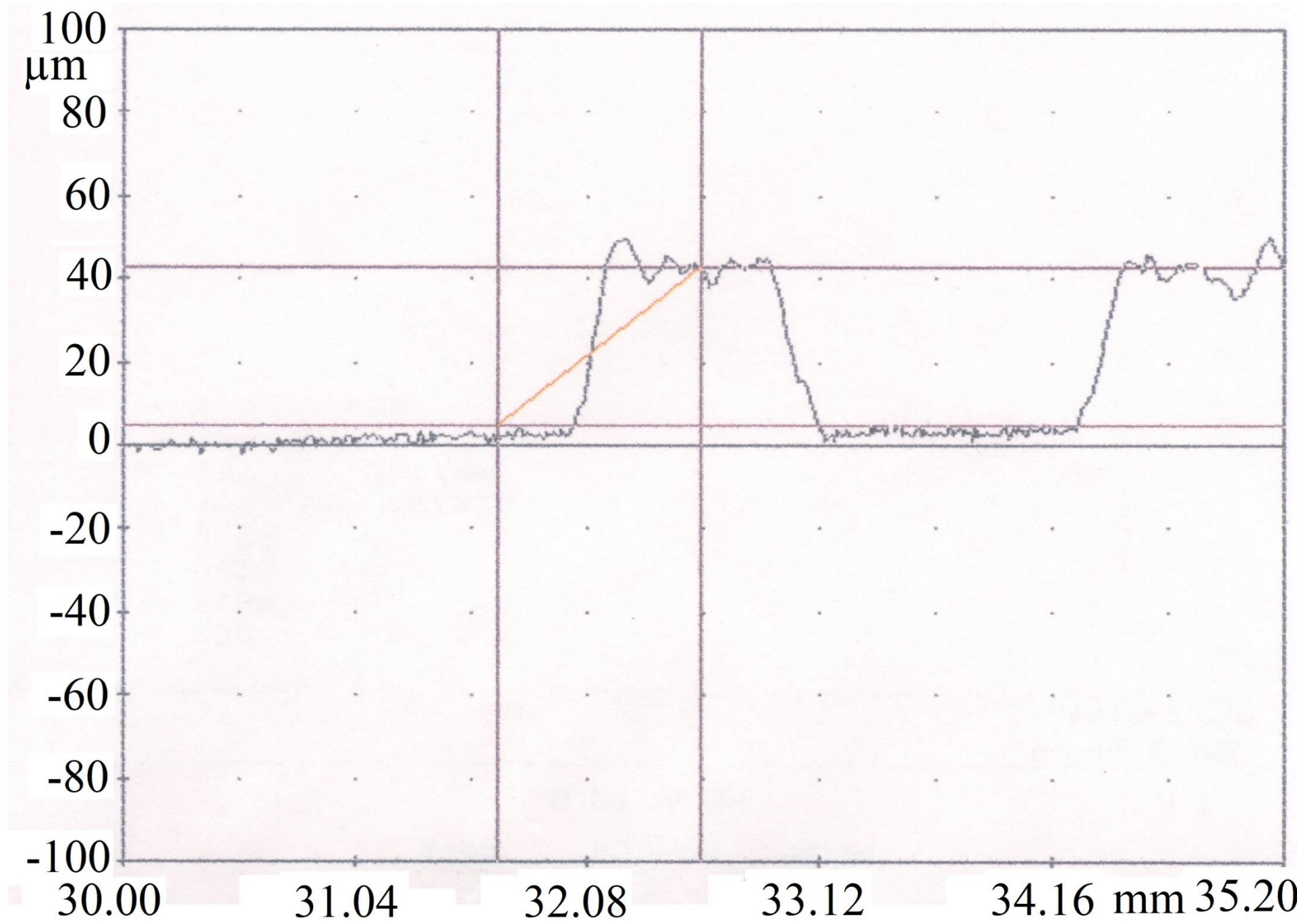
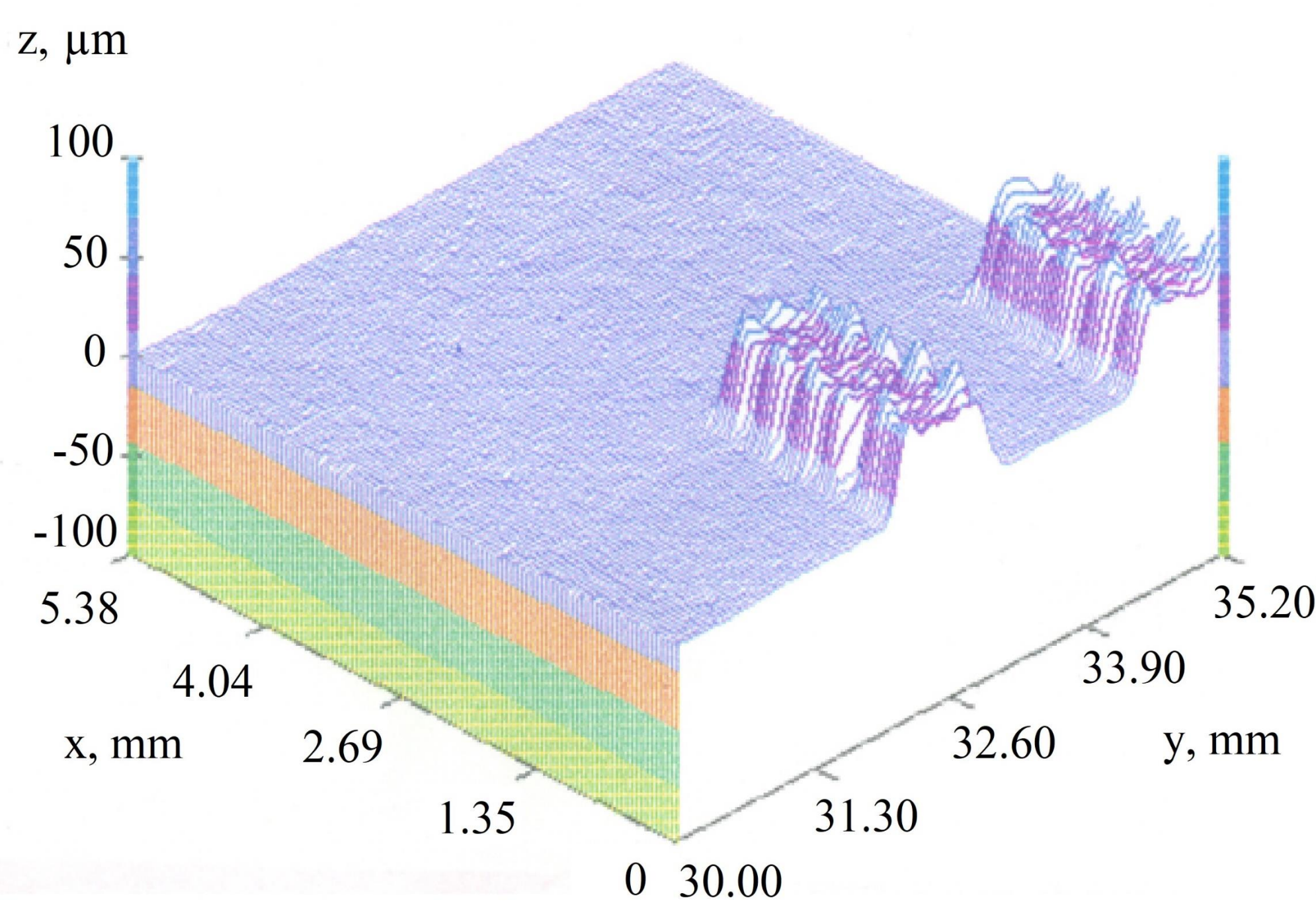
Technology:

The paste for screen-printing of thick films was obtained on roller paste by mixing MgAl₂O₄ ceramic powder (58 %), organic solvent and organic bond (30 %), lead-free organic oxide powder (8 %) and Bi₂O₃ (4 %).



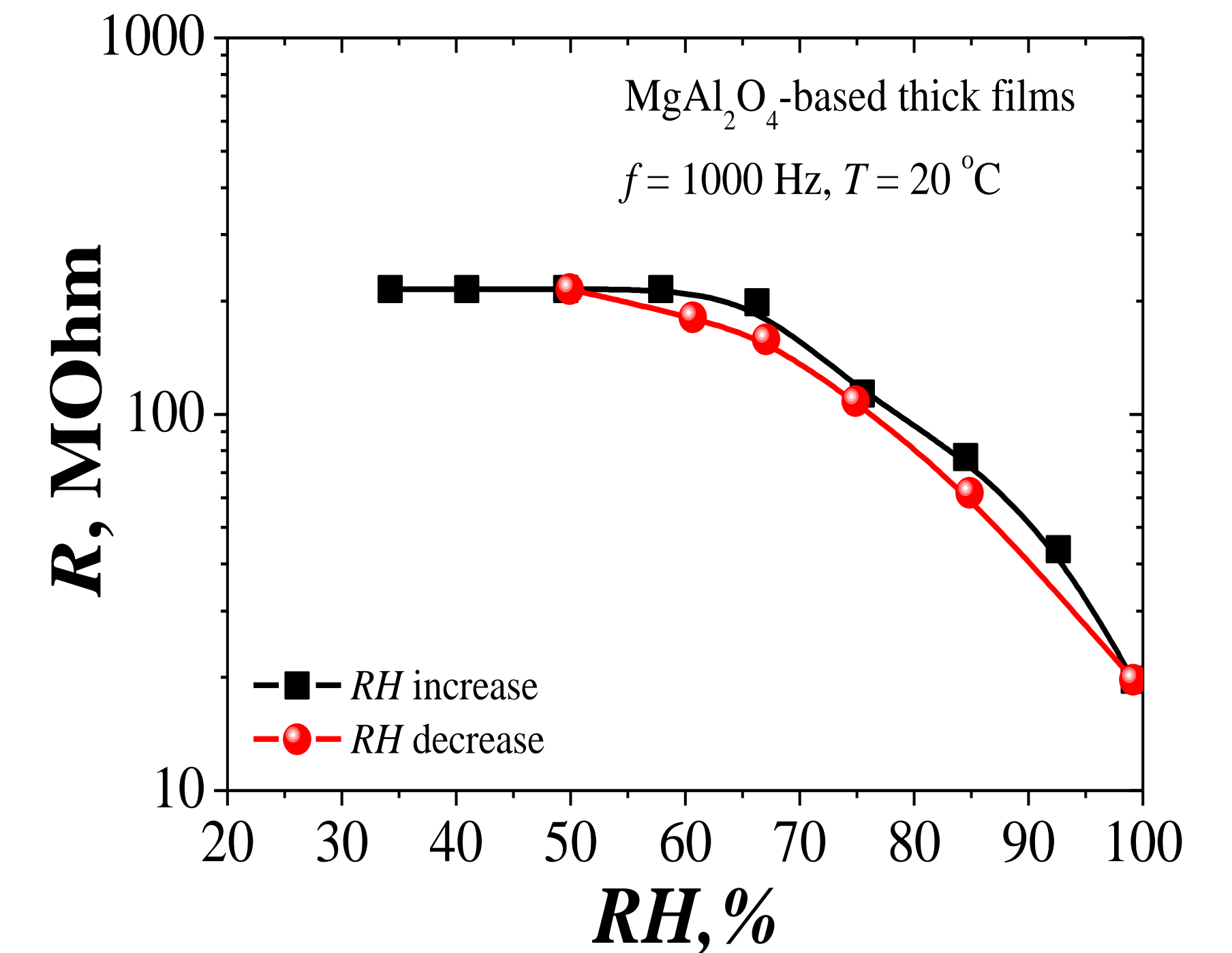
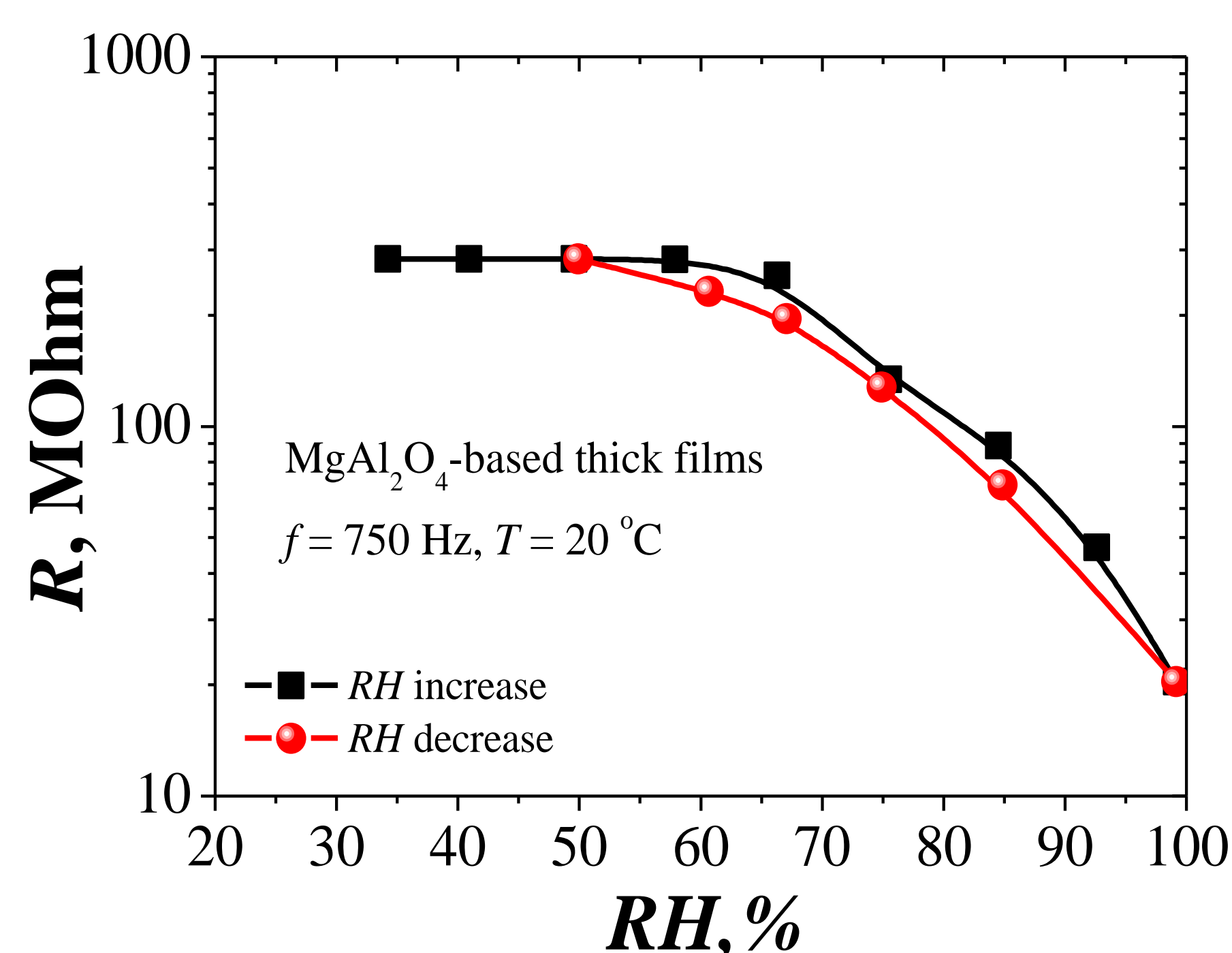
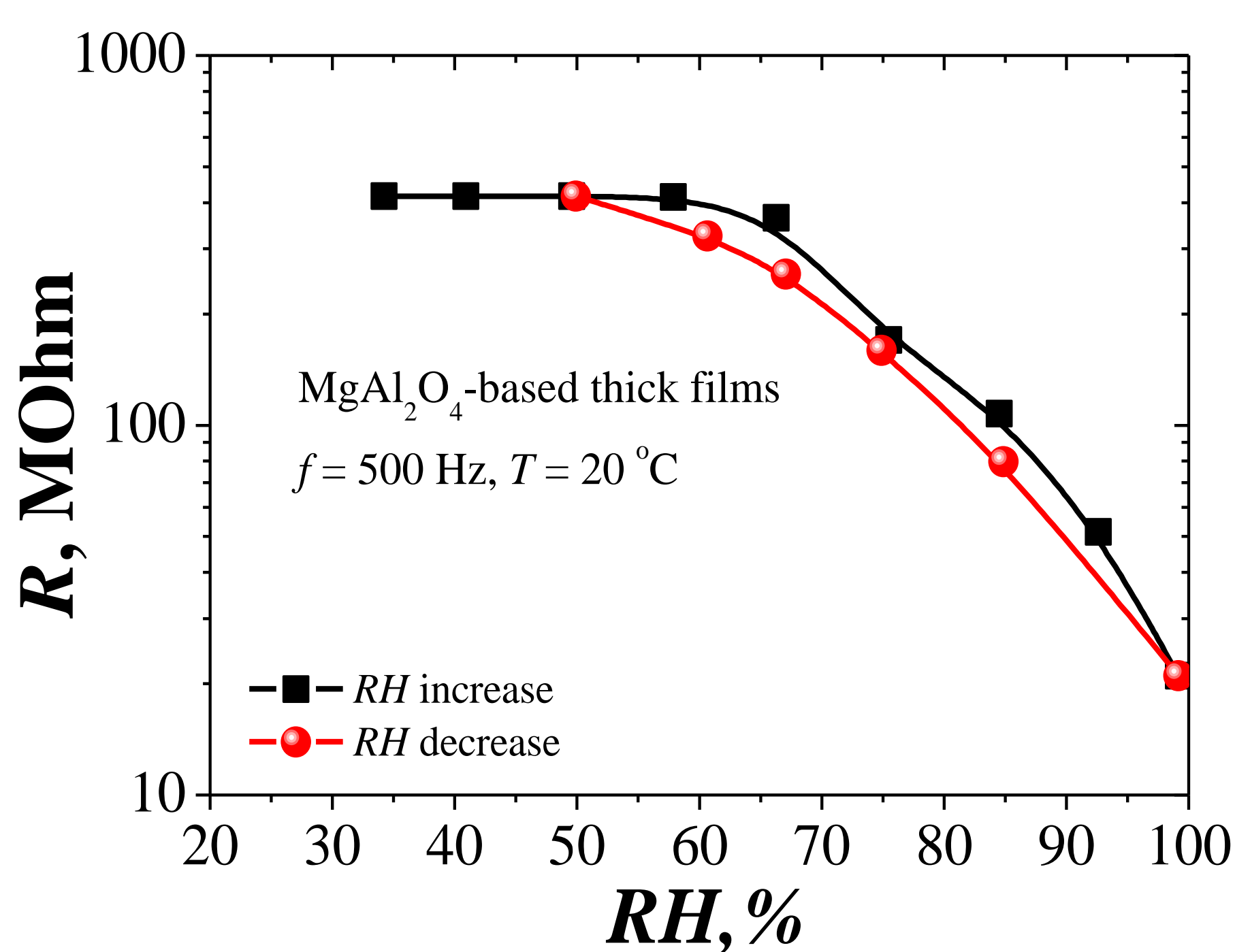
Investigations of electrophysical properties of one-layered humidity-sensitive thick films based on MgAl₂O₄ ceramics formed on Rubalit (Al₂O₃) substrates were performed. The obtained thick films exhibit typical features of spinel structure with crystallographic parameters, it have a good surface morphology, as well as high values of humidity sensitivity. The thick films have a sufficiently high humidity sensitivity in the range of RH from 55 to 99%, which is expressed in a relative change in their electrical resistance by 1...1.5 orders of magnitude. Their significant drawback is the limited humidity sensitivity from low values of RH, as well as the appearance of hysteresis in the measuring cycles of electrical resistance during increase and decrease of RH as a result of degradation test (actual exposure of samples for 240 hours at 40 °C and RH = 95%) due to imperfection of porous structure in the transition region between thick films and the substrate.

Topology and XRD data

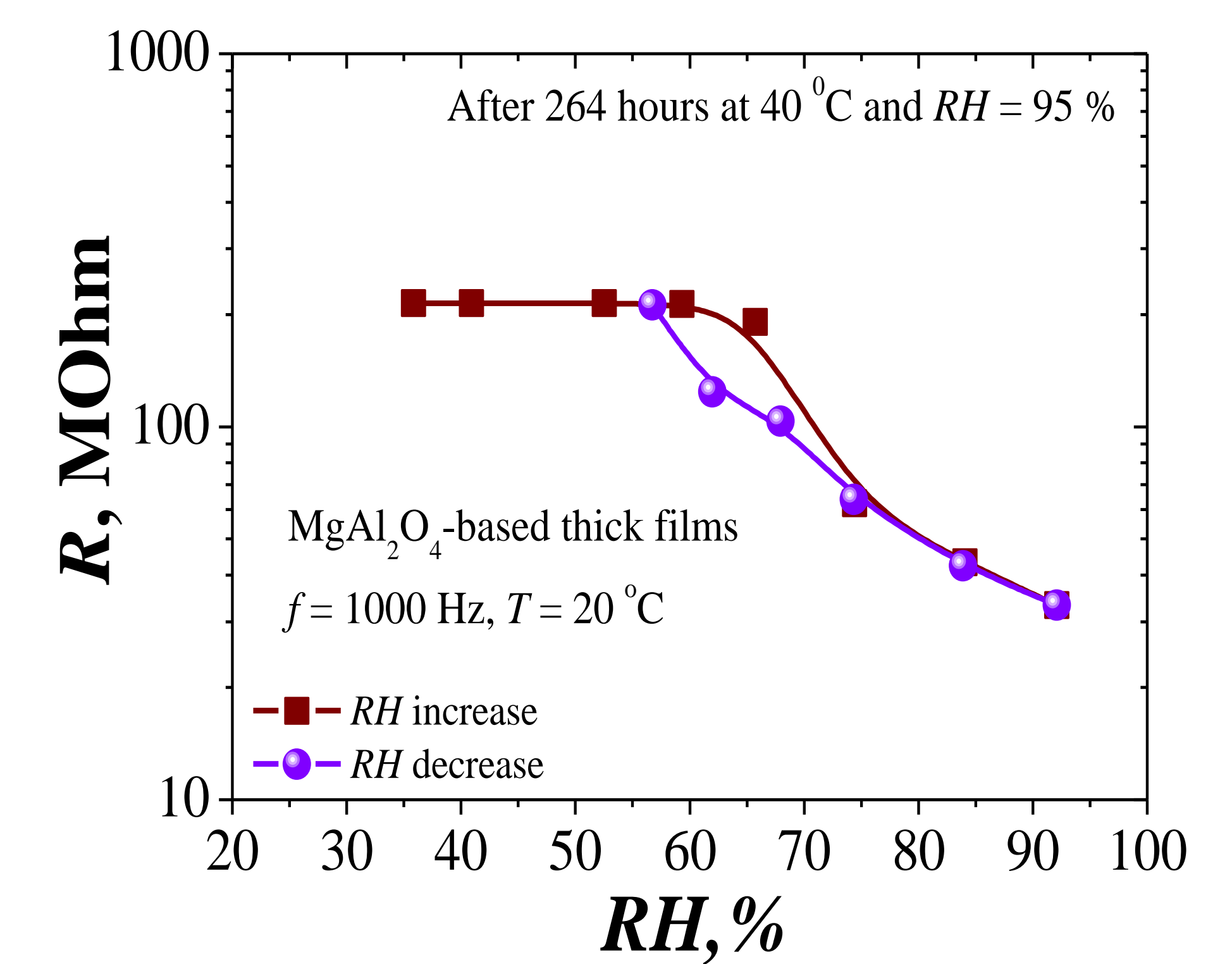
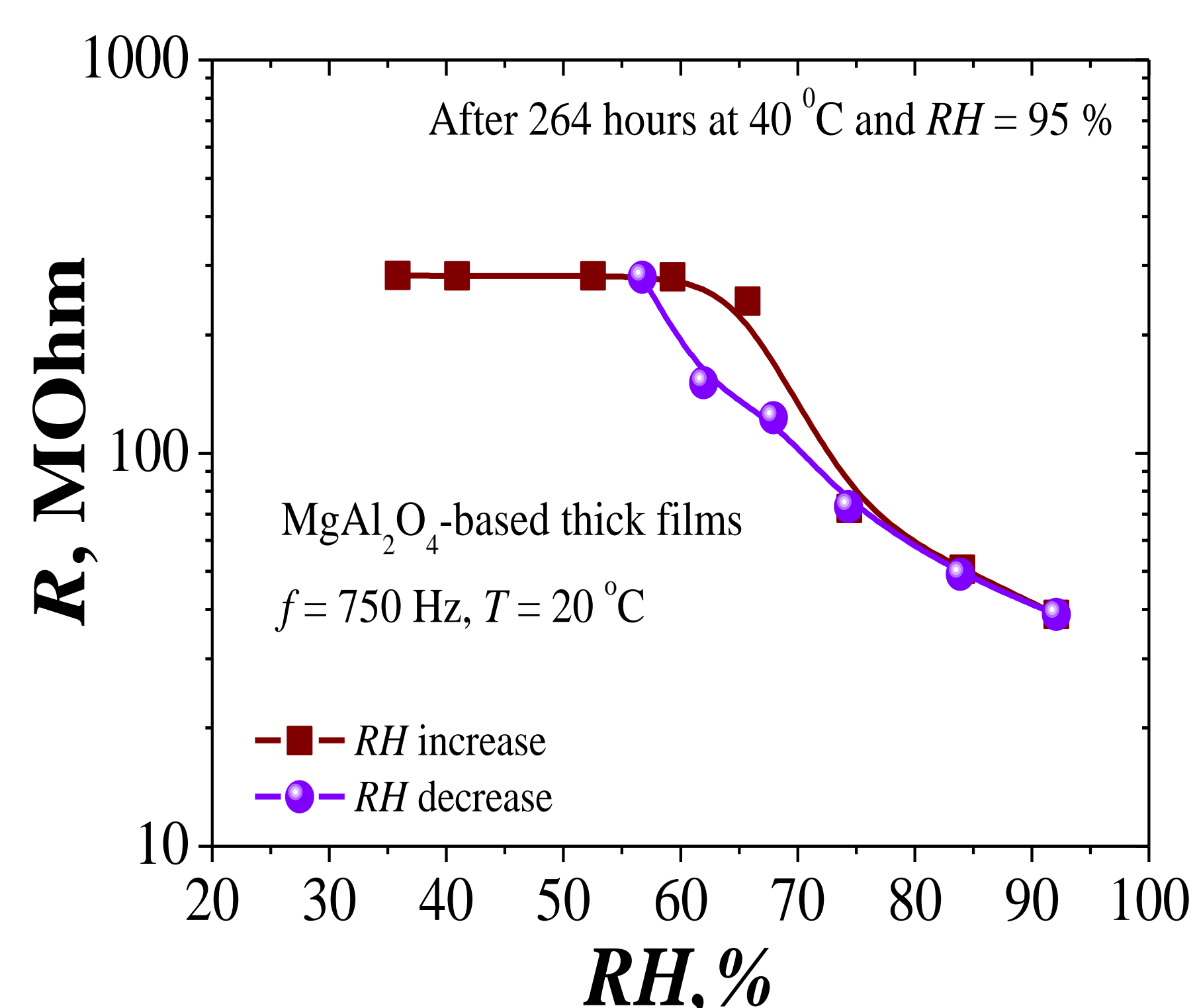
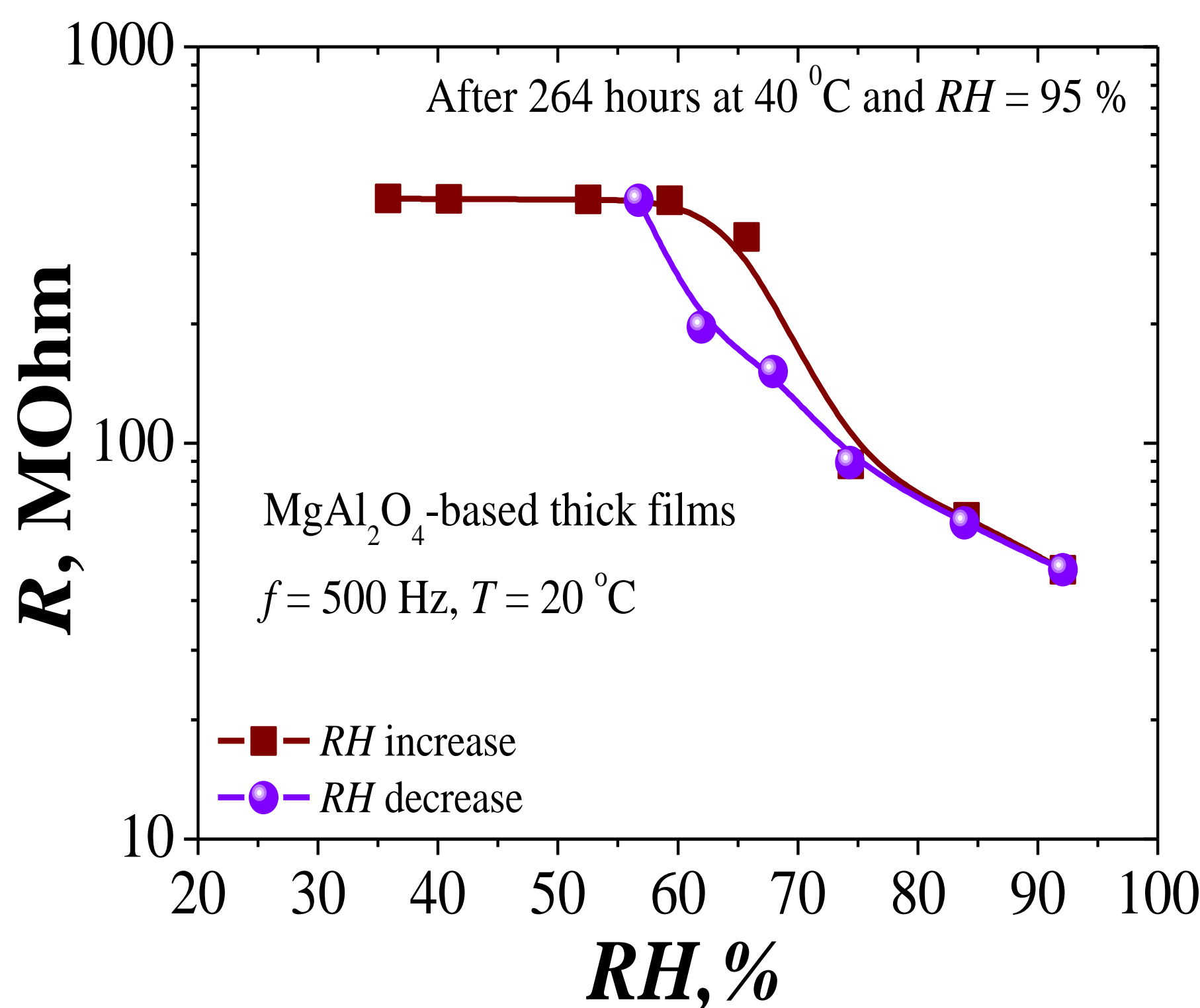


The disadvantage of obtaining paste is their high viscosity. In order to eliminate this disadvantage, corrections were made for the content of Bi₂O₃, glass MB-60, organic bond SM-2 and pine oil. To clarify the crystal structure the Rietveld method was used. For this case a two-phase model is chosen: the dominant phase is a spinel with a cubic structure and an additional MgO phase with a cubic NaCl-type structure. It is shown that of additional phase is 1.0 wt. %/ According to the profile analysis, tetragonal deformation of the cubic spinel was not observed. Content of additional phase after final cycle of refinement is 0.2(2) weight. %, indicating that it is almost completely absent.

Exploitation properties of thick films before ageing test



Electrical properties of thick films after ageing test



Humidity-sensitive thick films obtained directly on Rubalit substrates have a sufficiently high humidity sensitivity in the range of RH from 55 to 99 %, which is expressed in a relative change in their electrical resistance by 1...1.5 orders of magnitude. Their significant drawback is the limited sensitivity of low values of RH, as well as the emergence of hysteresis in the measuring cycles of the electric resistance in the case of increase and decrease of explosives as a result of the degradation test (the actual exposure of samples for 240 hours at 40 °C and RH = 95 %). This effect, evidently, is due to the imperfection of the porous structure of thick films based on MgAl₂O₄ ceramics in the transition region between the thick films and substrate.

