

Properties of magnesium titanate ceramic obtained by two stage sintering

S. Filipovic¹, N. Obradovic¹, V. B. Pavlovic¹, D. Kosanovic¹, M. Mitric², V. Paunovic³, V. Pouchly⁴, M. Kachlik⁴, K. Maca⁴

¹ Institute of Technical Science of SASA, 11000 Belgrade, Serbia,

² "Vinča" Institute of Nuclear Sciences, University of Belgrade, 11001 Belgrade, Serbia,

³ Faculty for Electronics, University of Nis, 18000 Nis, Serbia,

⁴ CEITEC BUT, Brno University of Technology, Technicka 10, 61600 Brno, Czech Republic

Abstract

The aim of this paper was investigation of structural and electrical properties of magnesium titanate ceramic obtained mechanochemically and subjected to two stage sintering process. Mixtures of MgO and TiO₂ were treated in a planetary ball mill for several time intervals ranging from 0 to 160 minutes. Powders prepared in this way were two stage sintered, at 1400 °C in air in the first stage, and then post-sintered by pressure assisted technique Hot Isostatic Pressing (HIP) at 1280 °C in argon atmosphere with a pressure of 200 MPa. X-ray diffraction was performed in order to established phase composition of obtained ceramics. Densities of sintered samples were measured by Archimedes method. The values of density were over 96 % of theoretical one and pure MgTiO₃ phase was observed. Morphology of sintered bodies was investigated by SEM, and micrographs indicate the final sintering stage and very dense ceramics. Electrical measurements were performed in the microwave field of frequency.

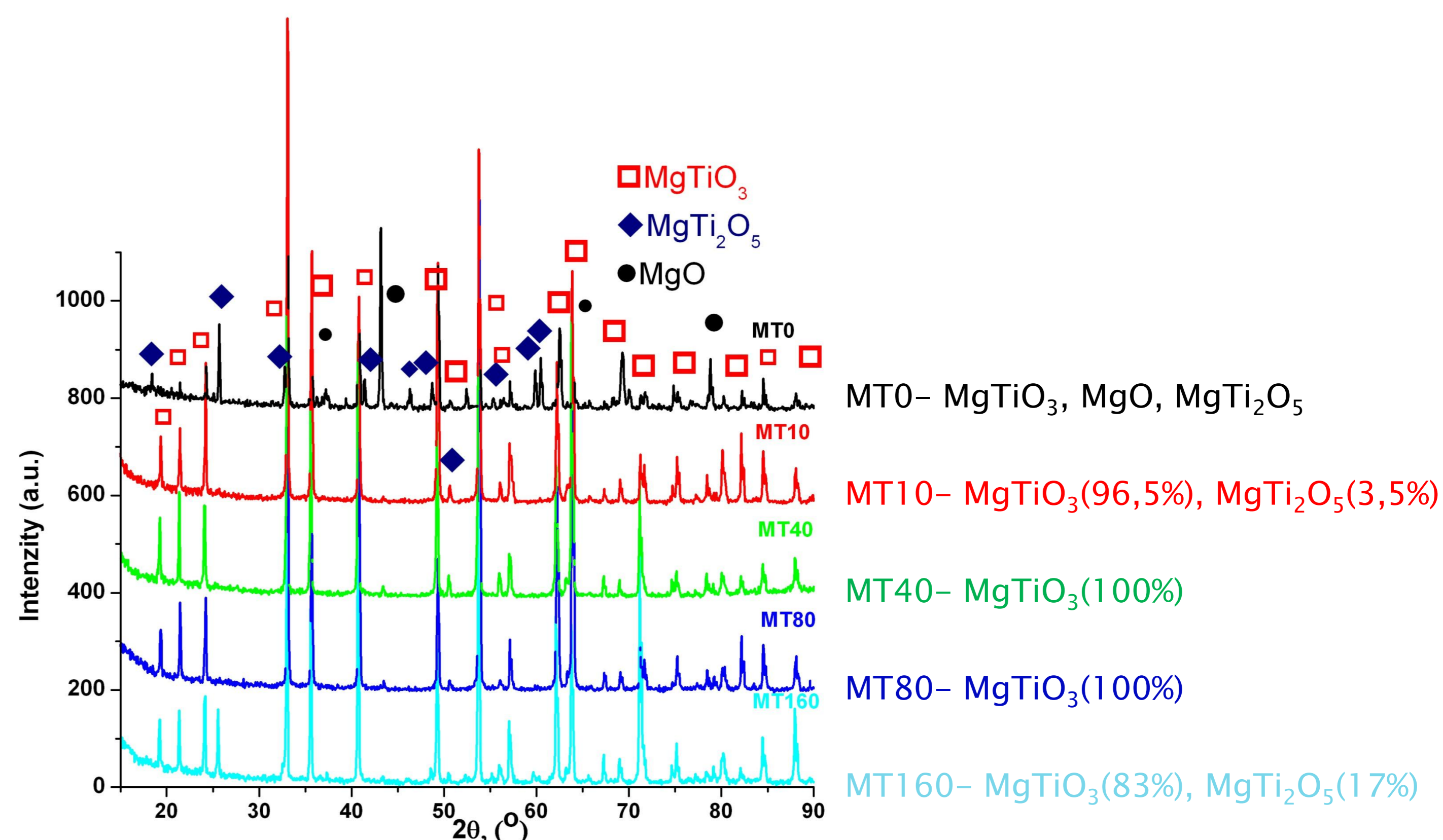
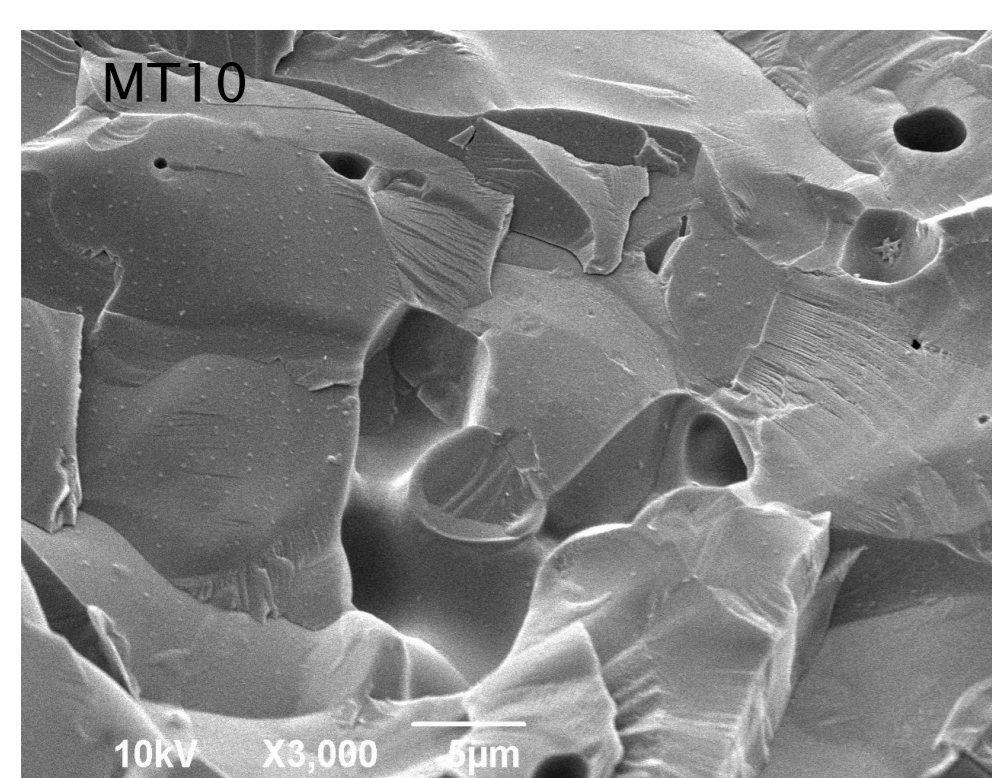
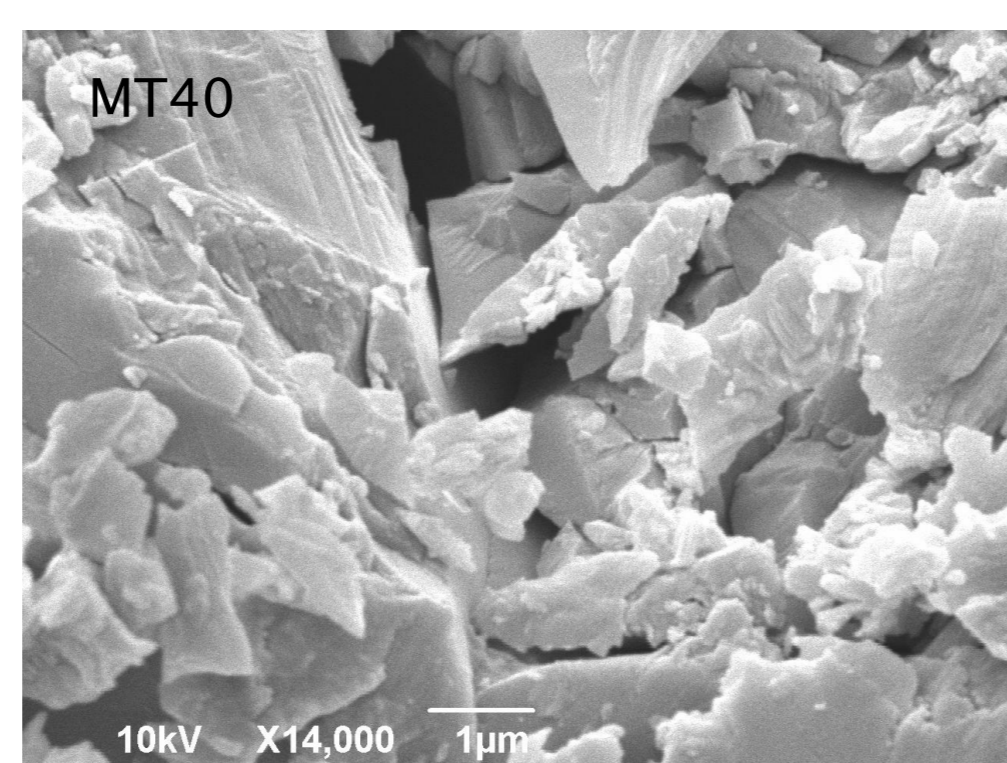


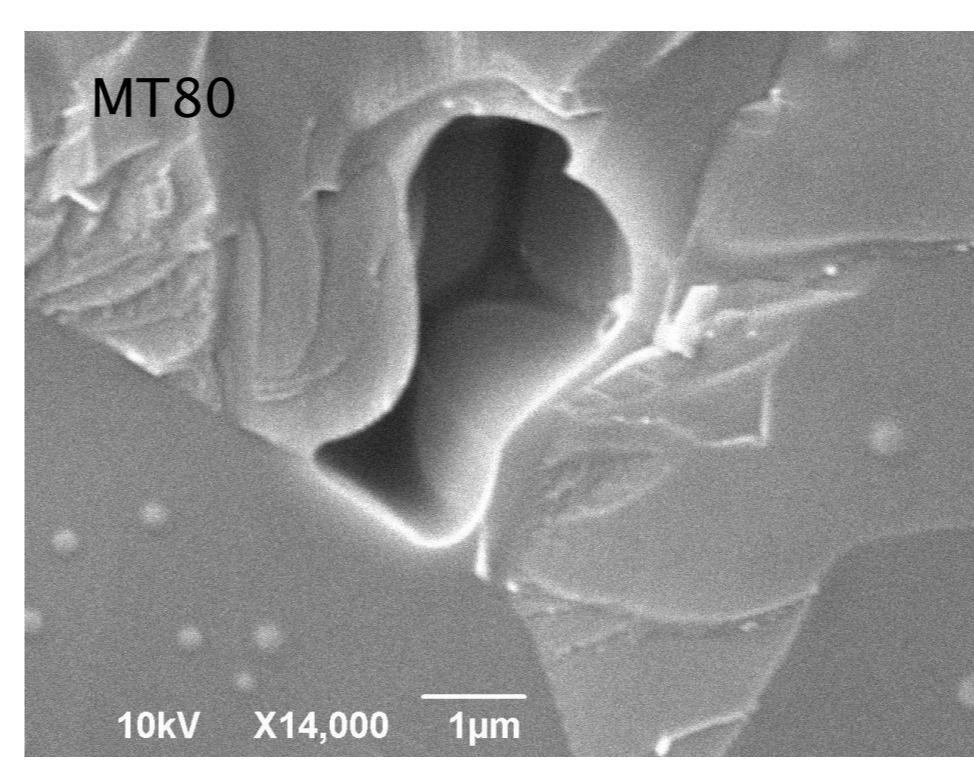
Fig. 1. X-Ray diffraction patterns



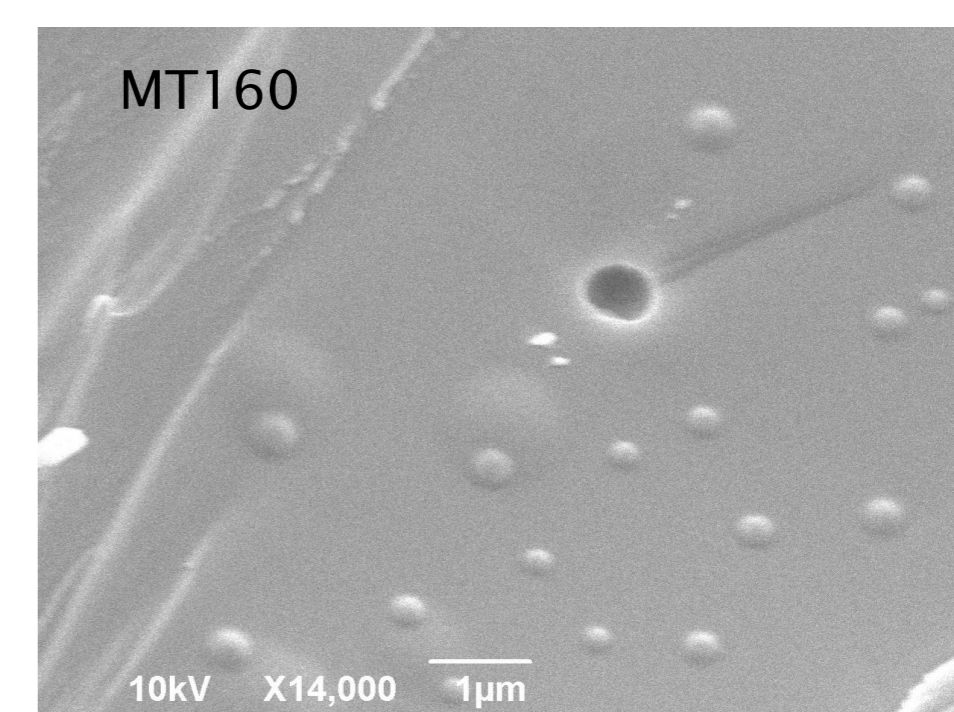
-Close porosity
-Small dots
-Rest of other phase



-Sintering of agglomerates, polygonal shaped pores because of agglomerates presence



- Compact structure with closed spherical pores



-Compact structure with some rare closed pores

Fig. 2. SEM micrographes of sintered samples

Relative and absolute densities of samples sintered by HIP at 1280°C for 3 h in Ar.

Sample	Absolute density [g·cm ⁻³]	Relative density [%]
MTO - 0	-	-
MTO - 10	3.78	94.6
MTO - 40	3.74	93.6
MTO - 80	3.84	95.9
MTO - 160	3.84	96.1

Electrical properties at frequency of 1GHz

	ϵ_r	Q
MT0	37,3	1,3
MT10	35,8	2,8
MT40	59,5	2,9
MT80	36,6	2,4
MT160	54,9	2,7

Electrical properties at frequency of 2,5 GHz

	ϵ_r	Q
MT0	23,5	1,0
MT10	43,7	1,4
MT40	44,5	4,4
MT80	41,8	1,3
MT160	40,1	4,6

Conclusion

Two-stage sintered ceramics obtained shows extremely high density, over 96% for samples activated 160 minutes. X-ray diffraction pattern shows that pure MgTiO₃ phase is present in green bodies activated for 40 and 80 minutes. Presence of closed porosity, seen at SEM micrographs, along with pores of spherical shape suggests the final stage of sintering. Comparing the values of ϵ_r and Q we can conclude that the best values reach a sample MT40. It is because presence of second phase in others samples (MgTi₂O₅) produces lower values of investigated electrical properties.