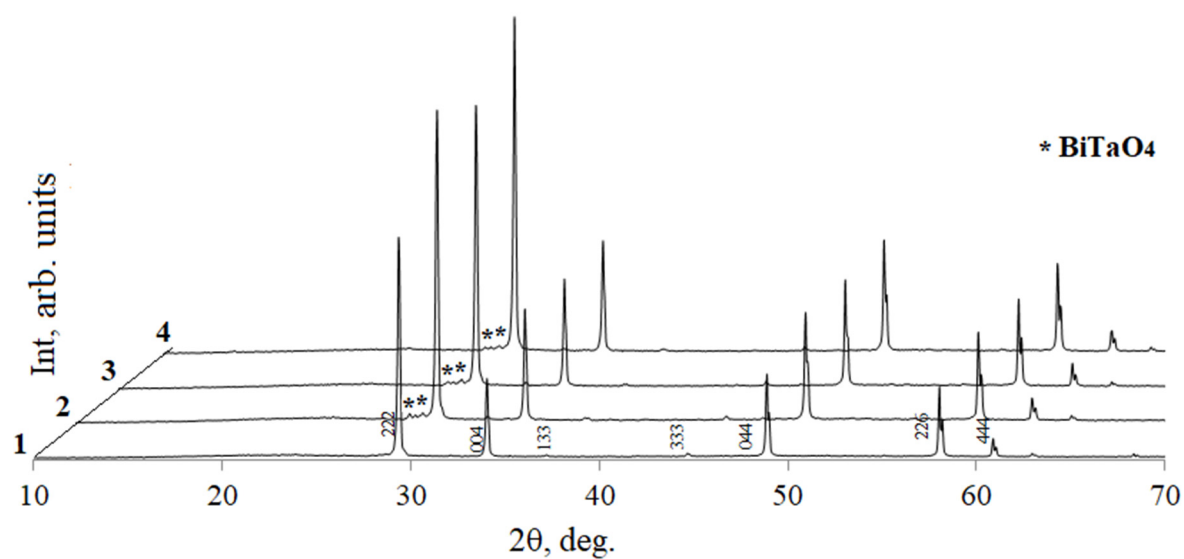
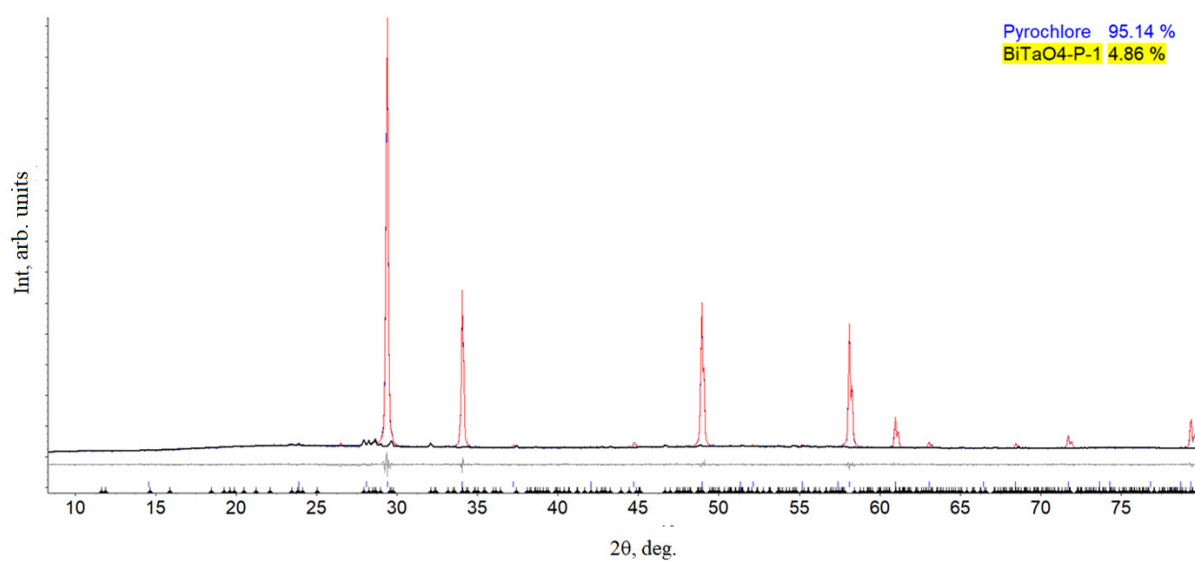


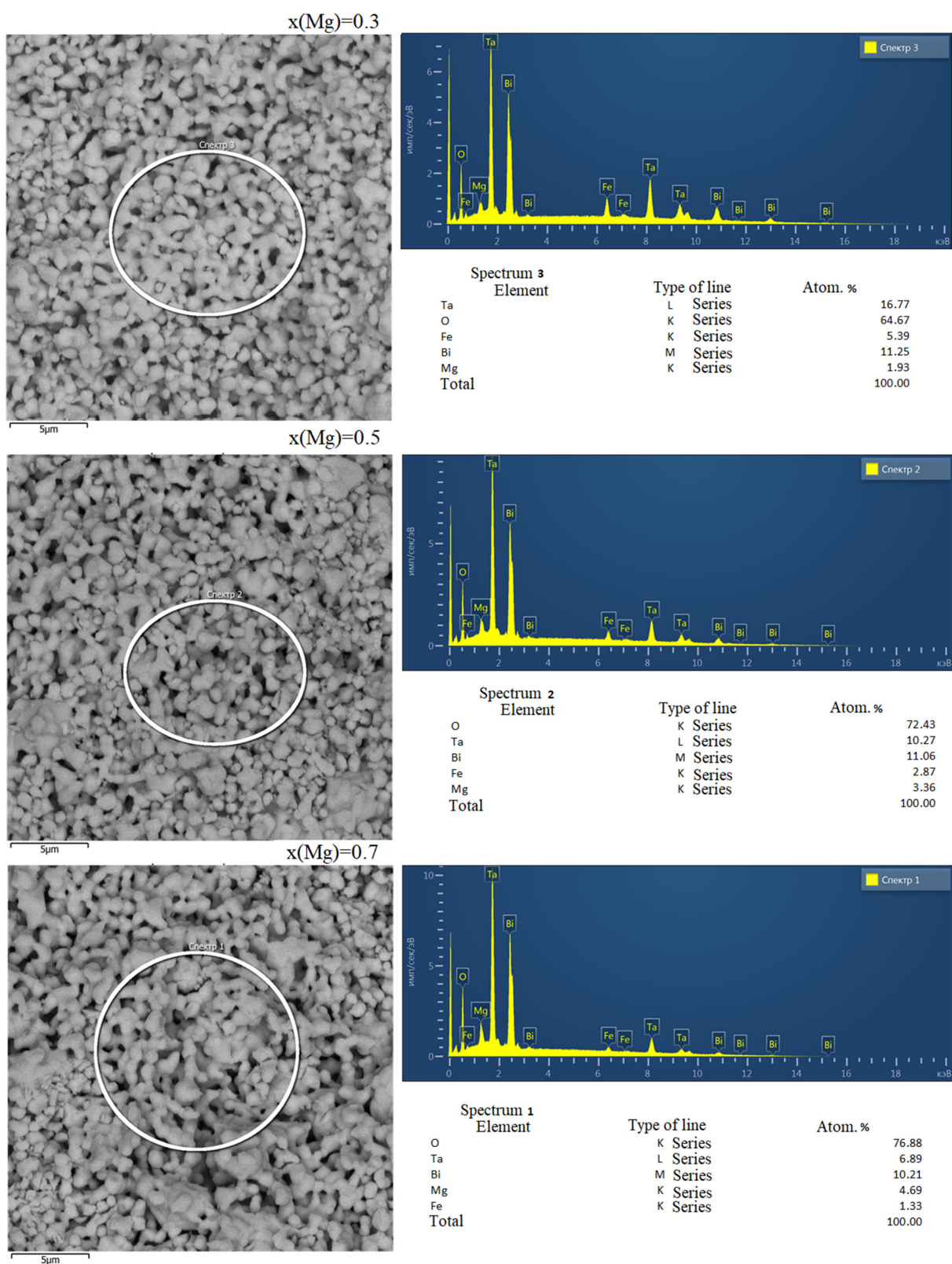
## Supplementary information



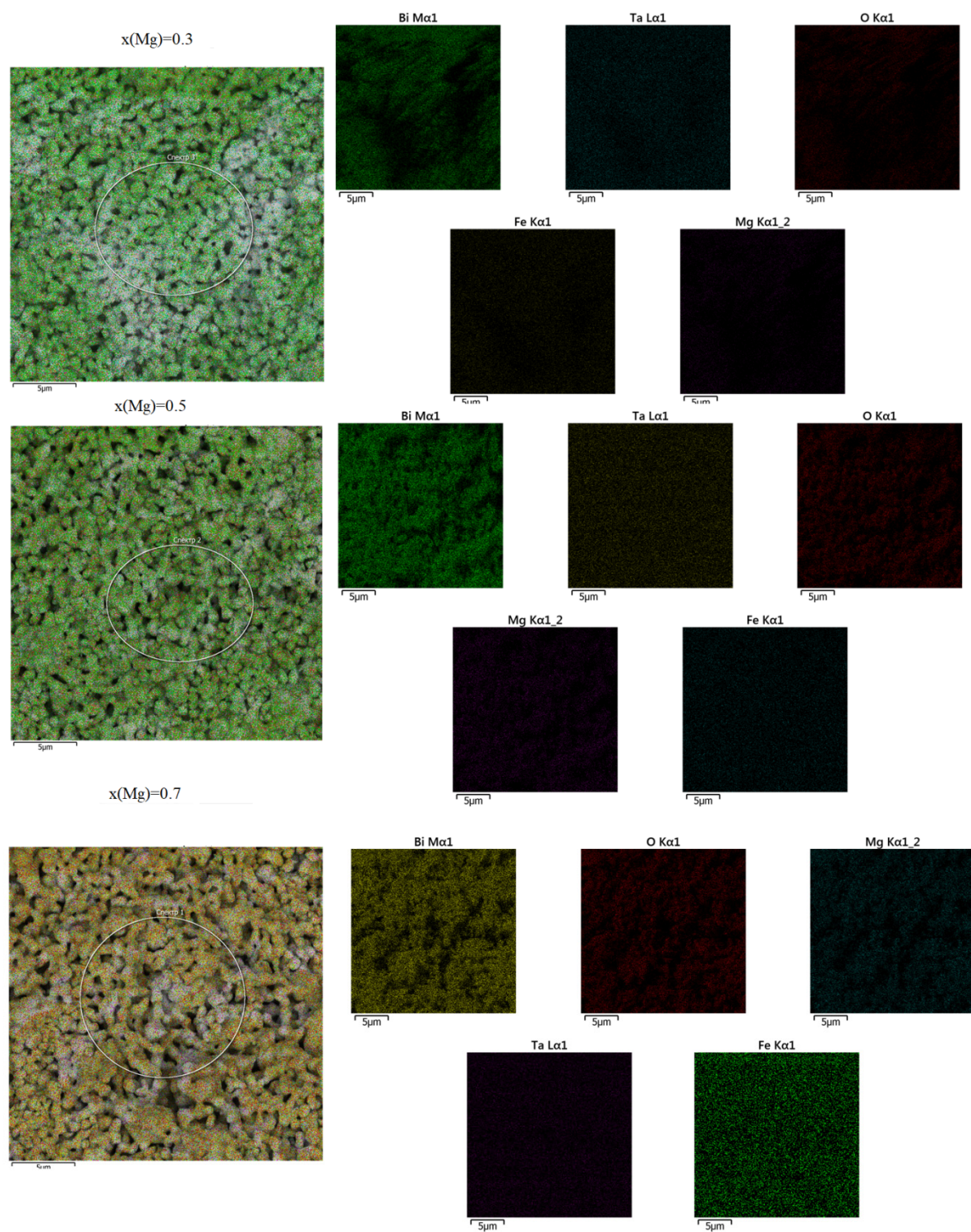
**Figure S1.** XRD patterns of  $\text{Bi}_2\text{Mg}_x\text{Fe}_{1-x}\text{Ta}_2\text{O}_{9.5-\Delta}$  at  $x=1(1)$ ,  $0.7(2)$ ,  $0.5(3)$ ,  $0.3(4)$  with  $\beta\text{-BiTaO}_4$  impurity



**Figure S2.** XRD patterns of  $\text{Bi}_2\text{Mg}_{0.7}\text{Fe}_{0.3}\text{Ta}_2\text{O}_{9.5-\Delta}$  with  $\beta\text{-BiTaO}_4$  impurity



**Figure S3.** Microphotograph and EDS analysis of the  $\text{Bi}_2\text{Mg}_x\text{Fe}_{1-x}\text{Ta}_2\text{O}_{9.5-\Delta}$  ( $x = 0.7, 0.5, 0.3$ )



**Figure S4.** Microphotograph and EDS elemental mapping of the  $\text{Bi}_2\text{Mg}_x\text{Fe}_{1-x}\text{Ta}_2\text{O}_{9.5-\Delta}$  ( $x = 0.7, 0.5, 0.3$ ) samples, synthesized at temperatures 1050 °C.

**Table S1.** Unit cell parameters of  $\text{Bi}_2\text{Mg}_{0.5}\text{Fe}_{0.5}\text{Ta}_2\text{O}_{9.5-\Delta}$  as a function of the temperature

T, °C	$a$ , Å	$\Delta a$ , Å
30	10.50183	0.00015
60	10.50278	0.00015
90	10.50404	0.0001
120	10.5057	0.00014
150	10.50676	0.00015
180	10.50835	0.00015
210	10.50976	0.00014
240	10.51112	0.00014
270	10.51287	0.00015
300	10.51457	0.00015
330	10.51644	0.00015
360	10.518	0.00012
390	10.51994	0.00014
420	10.52173	0.00015
450	10.52334	0.00015
480	10.52503	0.00016
510	10.52715	0.00015
540	10.52891	0.00015
570	10.53075	0.00011
600	10.53302	0.00015
630	10.53535	0.00015
660	10.53742	0.00011
690	10.53945	0.00014
720	10.54191	0.00012
750	10.54396	0.00015
780	10.54635	0.00011
810	10.54979	0.00015
840	10.55171	0.00015
870	10.55441	0.00015
900	10.55663	0.00015
930	10.5599	0.00015
960	10.56255	0.00016
990	10.5657	0.00014
1020	10.56847	0.00014
1050	10.57159	0.00014
1080	10.57455	0.0001
1110	10.57607	0.0001
1140	10.57653	0.0001
1170	10.57403	0.0001
1200	10.57071	0.0001

**Table S2.** Thermal expansion coefficients (TECs) of  $\text{Bi}_2\text{Mg}_{0.5}\text{Fe}_{0.5}\text{Ta}_2\text{O}_{9.5-\Delta}$  as a function of the temperature

T, °C	TECs $\times 10^6$ °C <sup>-1</sup>
30	3.611
90	3.946
150	4.28
210	4.615
270	4.948
330	5.282
390	5.615
450	5.948
510	6.281
570	6.613
630	6.945
690	7.277
750	7.608
810	7.938
870	8.268
930	8.598
990	8.927
1050	9.256