

SYNTHESIS AND CRYSTAL STRUCTURE OF NEW AURIVILLIUS PHASES

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A number of new perovskite-like layered oxides $A_{m-1}Bi_2B_mO_{3m+3}$, where A=Ca, Sr, Pb, Ba, Th, Nd and B= Ti, Nb, Ga, Mn, Fe, m – number of perovskite layers, were synthesized by conventional two-stage solid-state reaction of the constituent oxides (1 stage: $t=770-800^\circ\text{C}$ during 1.5 hour, 2 stage: $t=1020-1050^\circ\text{C}$ during 2 hours). As a result the compounds with the following compositions were obtained: $\text{Bi}_3\text{NdCaTi}_4\text{O}_{15}$, $\text{Bi}_7\text{Ca}_2\text{Ga}_{0.5}\text{Nb}_{5.5}\text{O}_{27}$, $\text{Bi}_5\text{CaFe}_{0.5}\text{Nb}_{3.5}\text{O}_{18}$, $\text{Bi}_7\text{Pb}_2\text{Mn}_{0.5}\text{Nb}_{5.5}\text{O}_{27}$, $\text{Bi}_{11}\text{CaGaTiNb}_6\text{O}_{36}$, $\text{Bi}_9\text{Ca}_3\text{TiNb}_7\text{O}_{36}$, $\text{Bi}_7\text{SrTi}_5\text{NbO}_{24}$, $\text{Bi}_9\text{Th}_{0.5}\text{Sr}_{0.5}\text{Nb}_6\text{O}_{30}$, $\text{Bi}_7\text{Th}_{0.5}\text{Ba}_{0.5}\text{Ti}_6\text{O}_{24}$, $\text{Bi}_{2.7}\text{Th}_{0.15}\text{Ba}_{0.15}\text{TiNbO}_9$. The number of perovskite layers m in the obtained compounds was found to vary from 1.5 up to 4. The chemical composition of all the substances was confirmed by energy-dispersive X-ray spectroscopy using HP-EDXRF spectrometer (Epsilon 5, PANalytical, Almelo, The Netherlands). Powder X-ray diffraction shows that the compounds adopt orthorhombic structures except $\text{Bi}_7\text{SrTi}_5\text{NbO}_{24}$ which is tetragonal. Chemical compositions, lattice parameters and space groups of the investigated oxides are listed below.

$\text{Bi}_9\text{Th}_{0.5}\text{Sr}_{0.5}\text{Nb}_6\text{O}_{30}$ ($m=1.5$) $a= 5.4606(1)$ Å, $b= 5.4429(1)$ Å, $c= 20.736(1)$ Å (Cmmm),
 $\text{Bi}_7\text{Ca}_2\text{Ga}_{0.5}\text{Nb}_{5.5}\text{O}_{27}$ ($m=2$) $a= 5.4610(2)$ Å, $b= 5.4409(1)$ Å, $c= 24.974(5)$ Å ($A2_1ma$),
 $\text{Bi}_5\text{CaFe}_{0.5}\text{Nb}_{3.5}\text{O}_{18}$ ($m=2$) $a= 5.4441(1)$ Å, $b= 5.4685(7)$ Å, $c= 25.105(7)$ Å ($A2_1ma$),
 $\text{Bi}_7\text{Pb}_2\text{Mn}_{0.5}\text{Nb}_{5.5}\text{O}_{27}$ ($m=2$) $a= 5.4744$ (1) Å, $b= 5.4852(1)$ Å, $c= 25.422(7)$ Å ($A2_1ma$),
 $\text{Bi}_{11}\text{CaGaTiNb}_6\text{O}_{36}$ ($m=2$) $a= 5.4230$ (1) Å, $b= 5.4417(2)$ Å, $c= 25.112(4)$ Å ($A2_1ma$),
 $\text{Bi}_9\text{Ca}_3\text{TiNb}_7\text{O}_{36}$ ($m=2$) $a= 5.4603(1)$ Å, $b= 5.4366(8)$ Å, $c= 24.922(6)$ Å ($A2_1ma$),
 $\text{Bi}_{2.7}\text{Th}_{0.15}\text{Ba}_{0.15}\text{TiNbO}_9$ ($m=2$) $a= 5.4040(8)$ Å, $b= 5.4265(7)$ Å, $c= 25.161(4)$ Å, (Fmmm),
 $\text{Bi}_7\text{SrTi}_5\text{NbO}_{24}$ ($m=3$) $a= 3.8442$ (1) Å, $b= 3.8442(1)$ Å, $c= 32.917(2)$ Å (I4/mmm),
 $\text{Bi}_7\text{Th}_{0.5}\text{Ba}_{0.5}\text{Ti}_6\text{O}_{24}$ ($m=3$) $a= 5.4255$ (2) Å, $b= 5.4143(3)$ Å, $c= 33.127(1)$ Å, (Fmm2),
 $\text{Bi}_3\text{NdCaTi}_4\text{O}_{15}$ ($m=4$) $a= 5.3978(1)$ Å, $b= 5.4019(1)$ Å, $c= 40.641(5)$ Å ($A2_1ma$).