crystal growth experiments using a flux of $CaCl_2$ [2] produced crystals of a rare structure type, which has only been found in $Sr_3NdFe_3O_9$ [3] so far. The structure was solved and refined in space group *Amma*, with *a*=5.32, *b*=26.64, *c*=5.47Å. The chemical composition determined from the structure refinement is $Ca_4Al_{0.24}(Fe,Mn)_{2.76}O_9$. Preliminary EDX results show a Fe/Mn ratio of approximately 77/23, which suggest that at least all the Mn is 4+, and possibly oxygen vacancies are present.

Barrier et al. [3] described the structure type as an intergrowth between the brownmillerite and the K_2NiF_4 structures. It also can be addressed as a *layered brownmillerite*. The structure type shows separated blocks of the brownmillerite-type. Each block has three layers: octahedral-tetrahedral-octahedral. The structural model in *Amma* requires disorder of right- and left-handed tetrahedral chains. $Ca_4Al_{0.24}(Fe,Mn)_{2.76}O_9$ shows rods of diffuse intensity in the XRD pattern. Their distribution suggests that the tetrahedral chains are alternating within the layers and the layers are stacked with disorder due to two possible translation vectors between the layers.

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Keywords: diffuse scattering; stacking faults

FA2-MS01-P11

Solid Solutions of $BiFe_{1-x}Mn_xO_3$ as a Base of New Multifunctional Materials.

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Solid solutions (SS) of $BiFe_{1-x}Mn_xO_3$ (BFMO)pose a great interest as a base of new materials simultaneously possessing ferroelectric and magnetic properties and high phase transition temperature values into paraelectic and/or paramagnetic states. At present there is contradictory information on properties of phases of the system, as the formation of stable crystal phases of PBMO depends from synthesis conditions greatly. As a result, the study of peculiarities of SS of $BiFe_{1-x}Mn_xO_3$ ($0\leq x\leq 0.5$ c $\Delta x=0.05$) at various synthesis conditions is of interest. The SS were synthesized with the use of solid solution reactions in two steps with intermediate grinding that provided the completeness of the reactions and the homogeneousness of the synthesized substance. As base reagents the high purity oxides were used. The X-ray study of samples was performed with the use of full-profile powder analysis (CuK_α- radiation). As a result, the present phases, their concentrations and cell sizes were determined. The concentration of the main phase ($BiFe_{1-x}Mn_xO_3$) with perovskite structure varied from 49 to 98% for different compositions and was dependent from synthesis temperature values. Bi_2O_3 and $Bi_2(Fe/Mn)_4O_9$ parasite phases have been detected. The monotonous changes of cell parameters of $Bi(Fe/Mn)O_3$ with rhombohedral phase of $BiFeO_3$ with the increase of x evidence the consecutive replacement of Fe ions with Mn ions. T_1=790°C, τ=10h, T_2=800°C, τ=10h was chosen to be the optimal temperature & time mode. The XRD study of the samples has shown that with the increase of Mn concentration in BFMO from x=0.05 to x=0.35 the monotonous decrease of cell parameters and, corresponding to it, of cell volumes is observed. This evidences, most definitely, the changes of chemical bonds Fe-O and Mn-O in perovskite structure with the formation of ordered structure clusters. The insignificant increase of sub-cell volumes at x>0.35 corresponds with this theory. It is also possible to assume that the physical properties in BFMO compositions with $0.3\leq x\leq 0.4$ would be extreme.

Keywords: ferroics; solid-state reactions; XRD

FA2-MS01-P12

Investigation of the Structure Role in the Formation of Twins.

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The reticular theory of twins assumes that a good lattice restoration, as is the prerequisite to have a good structural match, is the *necessary* condition for the formation of a twin. This is however not a *sufficient* condition, because the structure is not obliged to have the full symmetry of its lattice (merohedral crystals). In fact, for a twin to be able to form, a (partially) coherent interface must exist, where a structural continuity is realized between the individuals sharing that interface and allows the same structure to develop along at least two different but crystallographically related directions.

Several exceptions apparently contradicting the reticular theory are known in the literature, but these are normally explained by the theory of hybrid twins, where the coexistence of concurrent sublattices is taken into account [1,2].

To go beyond the reticular theory and include the role of the structures, two possibilities are here analysed.

1. Twins fully sharing only a slice of structure at the interface: the symmetry of this slice probably governs the relative orientation of the individuals.
2. Twins share a subset of atoms, (especially larger ones) and the symmetry of the subset is higher than the intersection symmetry of the structure of the individuals in their respective orientations. The additional symmetry operations of this subset may map the individuals onto each other and create a common substructure in the individuals.

For twins sharing only a slice of structure, a systematic approach would require the use of *diperiodic groups* and *sectional layer groups of space groups*, analyzed in Volume E of the *International Tables for Crystallography*. The slice shared by a pair of individuals should have a diperiodic group that is a supergroup of the intersection of the