XRD Study of Sol-Gel Preparation of the Materials with Radioluminescent Properties

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Inorganic radioluminescent materials are widely used for radiation detectors (it means also for the detection of X-rays). They are mainly based on oxide materials. These materials can be prepared by classical way (e.g. from melt), but these procedures represent some disadvantages. Therefore, the alternative methods of preparation are studied. One of these methods is sol-gel method. Using this method, we have prepared some oxidic phases that have radioluminescent properties. Yttrium silicates phases (Y_2SiO_5 and $Y_2Si_2O_7$) and zinc oxide (ZnO) are successfully used as materials for scintillation detectors. Sol-gel method reduce the temperature of preparation under 1000°C and one can obtain more homogeneous materials in comparison with classical ceramics methods. This method also makes the application of doping elements possible.

Resulting samples and intermediates were thoroughly studied by powder X-ray diffraction. Phase analysis was carried out using Rietveld method. X-ray diffraction study reveals, that the crystallisation of the final phase in the case of Y_2SiO_5 starts at 600°C and is completed at 1000°C. No broad band at about 20 ° (2θ) was observed in XRD pattern indicating formation of amorphous phase. In the case of $Y_2Si_2O_7$, we have observed similar thermal behaviour and uni-phase material was observed at the treatment temperature of 1100°C.

The samples of ZnO (resp. Ga-doped ZnO) were prepared by different methods. First used method was citrate method, which consists of decomposition of nitrates in the presence of citric acid. Second method is based on oxalate salts precipitation and their decomposition by two possible ways. First decomposition is thermal decomposition (dry process) and second one consists of wet decomposition using hydrogen peroxide. All above mentioned methods lead to submicronic structures of ZnO. Final samples were characterized by conventional methods (X-ray diffraction, Electron microscopy). Using XRD (change of lattice parameters), we have followed the substitution of Ga-cation into ZnO structure.

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