SUMMARY OF NEW CONCLUSIONS OF PhD THESIS

Title: "*Synthesis $BiFeO_3$, doped-$BiFeO_3$ materials and study some of their properties*"

Specialization: Solid State Physics

Code: 62.44.01.04

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New conclusions

- The bismuth ferrite ($BiFeO_3$) material was successfully synthesized by solid state reaction, hydrothermal and sol-gel methods. The single phase $BiFeO_3$ powders were obtained by the sol-gel method with the optimal condition of calcination at 800 °C for 7 hours.
- A reduction of the band gap of $BiFeO_3$-based materials has been observed in the rare earth doped (Nd^{3+} or Gd^{3+}, Sm^{3+}, Y^{3+}) and co-doped (Nd^{3+} and Ni^{2+} or Gd^{3+} and Ni^{2+}) samples in comparison with that of the pristine one. The 2.02 eV band gap of the $BiFeO_3$ material can be reduced to 1.60 eV or 1.63 eV corresponding to $BiFeO_3$ materials doped with 15 mol% Gd^{3+} or co-doped with 15 mol% Nd^{3+} and 2.5 mol% Ni^{2+}.
- The ferromagnetic properties of $BiFeO_3$ materials can be significantly improved by rare earth doped (Nd^{3+}, Gd^{3+}, Sm^{3+}, Y^{3+}) and co-doped (Nd^{3+} and Ni^{2+} or Gd^{3+} and Ni^{2+}) materials. The saturation magnetization value *(Ms)* of the Gd^{3+} doped or Gd^{3+} and Ni^{2+} co-doped $BiFeO_3$ materials can be increased 8.9 or 10 times higher than that of the pure $BiFeO_3$ one, respectively.
- An enhancement of the ferroelectricity of pure $BiFeO_3$ is obtained for Gd^{3+} doped and Nd^{3+} and Ni^{2+} or Gd^{3+} and Ni^{2+} co-doped $BiFeO_3$ materials. The spontaneous electric polarization (*Ps*) and residual electric polarization (*Pr*) of the $BiFeO_3$ material are enhanced from Ps = 1.26 μC/cm^2, Pr = 0.75 μC/cm^2 up to Ps = 6.89 μC/cm^2, Pr = 3.70 μC/cm^2 for doping 10 mol% Gd^{3+}, and Ps = 31.17μC/cm^2, Pr = 19.22 μC/cm^2 for co-doping 15 mol% Gd^{3+} and 2.5 mol% Ni^{2+} into the pure $BiFeO_3$ material.

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