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TEM, EPR, Mossbauer studies on nano ($CuxBa_{1-x}$)(Alx¬Fe¬$_{12-x}$)O^{19}

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We report the influence of Cu^{2+}/Al^{3}+ substitution and magnetic properties in the nano particles of ferrite of basic composition CuxBa1-x.(AlxFe12-x)O19 ($0.0 \leq x \leq 1.0$) synthesized by solid-state reaction route method. X-ray diffraction (XRD), transmission electron microscopy (TEM), electron paramagnetic resonance (EPR), Mossbauer, VSM, Fourier transformation infrared (FTIR) spectroscopy techniques, and magnetic measurement are used to investigate the structural and magnetic properties of the synthesized nano particles. XRD results confirm that all the samples are single-phase hexagonal in structure. The unit cell parameters "a" and "c" are calculated as from 6.276 to 5.777 Å and 23.195 to 23.00 Å respectively with variation of composition from x= 0.00 to 1.00. The average crystallite size of the synthesized nano particles was calculated through Scherrer formula and confirmed by TEM and was found to be 100 nm. FTIR results show the presence of two vibrational bands corresponding to tetrahedral and octahedral sites. EPR spectra are compositional dependent at lower Al/Cu concentration. EPR spectra are due to Fe^{3}+ with x=0 composition and x=1.0 is due to both Fe^{3}+ and Cu^{2}+. EPR results at room temperature reveals that it is ferromagnetic with composition x=0.0 and with x=1.0 it is paramagnetic. Copper is placed in the tetragonal elongation site with magnetically non-equivalent ions in the unit cell. These do not have strong exchange coupling between them. Nonlinear optical properties of the samples indicate that these ferrites are potential candidates for optical limiting applications. Mossbauer studies are suggesting that the sample is ferromagnetic with composition x=0.0 and with x=1.0 super paramagnetic. These results are supported by ESR and VSM studies. Magnetic properties are characterized by vibration sample magnetometer (VSM). All the magnetic properties are found to decrease with the increase in Al–Cu content, which is due to the occupation of the doped cations at the octahedral sites (12k and 2a) having spin of electrons in upward direction. In addition, the effects of the substituent agents on these properties of the barium ferrite powders are investigated.

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Effect of oil shale additions on high belite raw mix and clinker

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Raw mixes for high belite cement clinker (HBCC) have been designed on basis of chemical analyses of Egyptian raw materials with and without the additions of Egyptian oil shale obtained from Younis Gharb mine located at the Red Sea Coast in the Eastern desert of Egypt (calorific value ~2500 kcal/kg shale). LSF of the mix was maintained at 80%, silica modulus at 2.25 and C3A in the clinker not exceeding 4%. From raw mix design it was found that, with increase of % shale additions the limestone % in the raw mix decreases whereas % secondary compounds, SO3 and P2O5, increase in the clinker. Two raw mixes: One with about 11 wt% oil shale and one without shale as blank were selected for preparation of HBCC in the laboratory. The investigated firing temperatures were 1300 and 1350 oC. Characteristics of the produced high belite clinker, such as chemical composition, X-ray diffraction analysis, scanning electron microscopy besides physico-mechanical properties of its hydrated pastes have been determined and compared with the corresponding values of commercial ordinary Portland cement. It was found that, the most appropriate temperature for firing HBCC raw mixes is 1350oC. Generally, shale additions had slight effect on the physico-mechanical properties of the produced high belite clinker.

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