EXECUTIVE SUMMARY OF THE MINOR RESEARCH REPORT (File No*: 47-410/12 (WRO))* TITLED "*Structural and Electric-Magnetic Properties of Zr-Ti substituted Calcium Nanostructure hexaferrites"*

M-type calcium hexaferrites substituted with cobalt and zirconium was prepared by sol-gel process. The nanomaterials prepared by this method were of pure hexaferrites and particles in the nano range were obtained. Cobalt has a low magnetic moment 0.46μB and Zirconium is a non-magnetic ion, which provides stability to the lattice and calcium tends to improve the coercivity and better control of grain growth . The structural and electrical magnetic properties of Co^{2+} and Zr^{4+} substituted synthesized calcium hexaferrites were studied. The X-ray diffraction studies reveal that the samples are of space group $P6_3/mmc$ and are of single-phase magnetoplumbite (M) structure. The presence of the hexagonal ferrite phase can be identified by peaks at 2θ, to mention a few: (004), (006), (104), (106), (107), (201), (203), (213), (301), etc. The observed diffraction planes are relevant to the peaks of M type hexaferrites. The hexagonal crystal system with dominant (107) plane was obtained for all the samples. The lattice parameters 'a' and 'c' were measured and within the hexaferrite range. The lattice parameter 'a' was showing a negligible variation but value of 'c' was found to be slightly increasing as the substitution increased and the increase was around 0.5%. The cell volume was found to increase with the Co-Zr substitutions. The x-ray density and bulk density also increased as the substitution increased. The particle size was calculated by Debye Scherer formula and was found to be in the nano range and decreased as the substitution increased whereas the porosity increased. The Transmission electron microscopy and scanning electron analysis suggests the formation of hexagonal platelets and the particle size was in the nano range. All the samples showed hysteresis behaviour suggesting the particles were ferrimagnetic. From the hysteresis loops coercivity, saturation magnetisation and remanent magnetisation were extracted. Magnetic studies revealed that the saturation magnetisation and remnant magnetisation increases with substitution of cobalt and zirconium. The squareness ratio suggests that the particles are multi-domain particles. The samples have a better signal-to-ratio as the particle size was less than 50nm when calculated by Debye-Scherer formula and may be suitable for recording media. The electrical studies reveal the ferrite samples are semiconductor in nature. The dc resistivity decreases with temperature and drift mobility, conductivity, activation energy was calculated and the transition temperature for the ferrite to change from metal to semiconductor. The change in the behavior of the dielectric constant (ε) with temperature may be due to a magnetic transition where the material becomes a paramagnetic.