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Non-equilibrium dynamics in ferrian ilmenite low temperature magnetic properties

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This study aims at investigating the magnetic phase changes within the hematite-ilmenite solid solution, yFeTiO3(1-y)Fe2O3. This contribution focuses on the magnetic behaviour exhibiting non-equilibrium dynamics. Special attention has been given to compositions with y values ranging between 0.65 and 1.0, for which a transition into a spin glass state is expected at 100 K or below based on the work of Ishikawa and colleagues in the mid-1980. Two sets of synthetic ferrian ilmenites of y-values equal to 0.7, 0.8, 0.9, and 1.0 were available for this study. Non-equilibrium dynamics was explored through time dependent experiments of induced magnetization in both DC and AC magnetic fields. These experiments were complemented by more routine low-temperature magnetic measurements (ZFC/FC, RTSIRM) including hysteresis loop measurements.

All samples, except the pure ilmenite sample (y = 1.0), exhibit magnetic behaviours indicative of non-equilibrium dynamics over a wide temperature range which exceeds that expected based on previous work. The observed frequency dependent and amplitude non-dependent quadrature susceptibility peak at ˜ 40 K coincides with the spin glass phase transition in existing phase diagrams. However, time-dependant 0.1 mT induced magnetization data convincingly show non-equilibrium behaviour persisting at temperatures well above 40 K. For y =0.7 and 0.8, non-equilibrium behaviour persists to temperature approaching that of their Curie temperatures, which are 380 K and 320 K respectively. Non-equilibrium magnetic behaviour in the y = 0.9 sample appears restricted to temperatures below the quadrature susceptibility peak.