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Some characteristics of the ferrite $Ba_3Fe(II)_4Fe(III)_{28}O_{49}$

It is well known that oxides of the form $2BaO{-}11Fe_2O_3$ are used for the fabrication of permanent magnets because they exhibit better magnetic characteristics than the hexaferrite $BaO{-}6Fe_2O_3$. According to Brady [1], these materials are made of a mixture of the hexaferrite $BaFe_{12}O_{19}$ (with specific saturation magnetization, σ_S, equal to 72.0 emu g^{-1} at room temperature) and of the ferrite $Ba_3Fe(II)_4Fe(III)_{28}O_{49}$ ($\sigma_S = 79.6$ emu g^{-1} at room temperature). This oxide, containing divalent iron, crystallizes as the hexaferrite with a magnetoplumbite structure and, it is suggested, corresponds to the structural model MYS_N or $MT(S_N)_2$ ($Y = TS_N$) such that

$$M \equiv BaFe(III)_{12}O_{19}\ ;$$

$$T \equiv Ba_2Fe(III)_8O_{14}\ ;$$

$$(S_N)_2 \equiv 2(Fe(II)_2Fe(III)_4O_8)\ ,$$

and so

$$MYS_N \equiv Ba_3Fe(II)_4Fe(III)_{28}O_{49}\ .$$

It is noticeable that the specific saturation magnetization calculated for such a model ($\sigma_S = 67.4$ emu g^{-1}), assuming that it corresponds to the addition of the magnetization of each block, is lower than the value reported by Brady [1] for the specific saturation magnetization measured at room temperature ($\sigma_S = 79.6$ emu g^{-1}). Therefore the ferrite $Ba_3Fe(II)_4Fe(II)_{28}O_{49}$ was prepared and a measurement of its specific saturation magnetization was made.

A study of the reactivity of potassium ferrites $K_2O{-}nFe_2O_3$ with a molten barium salt led an investigation of the different metastable barium ferrites $BaO{-}nFe_2O_3$. Among them, the ferrite $3BaO{-}16Fe_2O_3$ ($Ba_3Fe(III)_{32}O_{51}$) presents the same ratio Fe/Ba = 32/3 as the oxide reported by Brady. The important characteristics of this new oxide, which have been described elsewhere [2], are that its X-ray diffraction pattern is very similar to that of the hexaferrite $BaFe(III)_{12}O_{19}$ and that its chemical composition and its specific saturation magnetization ($\sigma_S = 88.1$ emu g^{-1} at 4 K) agree with a type M_6Y' or M_6TS_L ($Y' = TS_L$) structural model such that

$$6M \equiv 6(BaFe(III)_{12}O_{19});$$

$$T \equiv Ba_2Fe(III)_8O_{14}\ ;$$

$$3S_L \equiv Fe(III)_{16}O_{24}$$

so that

$$3M_6Y' \equiv 8Ba_3Fe(III)_{32}O_{51}\ ,$$

in which S_L corresponds to an element with a vacancy spinel structure, $Fe(III)_6\ [Fe(III)_{10}\ \square_2]O_{24}$, where $\square$ represents a vacancy, similar to those of the oxide γFe_2O_3. The specific saturation magnetization calculated for this model is $\sigma_S = 88.0$ emu g^{-1}.

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A partial reduction of this vacancy ferrite, by treatment at 600° C in an oven swept by a mixture of hydrogen and nitrogen (1% H_2), saturated in water vapour (passed through a saturator, maintained at 50° C; $P_{H_2O} = 9.1$ torr) and equipped with a quenching system, produces an oxide, the composition of which (7.46 wt % Fe(II); 52.5 wt % Fe(III); 13.5 wt % Ba) is very close to that of the oxide $Ba_3Fe(II)_4Fe(III)_{28}O_{49}$ (of composition 7.49 wt % Fe(II); 52.42 wt % Fe(III); 13.81 wt % Ba). The specific saturation magnetization measured at a temperature of 4 K on this sample ($\sigma_S = 66.0$ emu g^{-1}) agrees with a type MYS_N structure ($\sigma_{S(calc.)} = 67.4$ emu g^{-1}). On the other hand, the specific saturation magnetization measured at room temperature ($\sigma_S = 49.6$ emu g^{-1}) is lower than that reported by Brady [1].

Consequently, although the existence of the ferrite $Ba_3Fe(II)_4Fe(III)_{28}O_{49}$ with a MYS_N structure seems plausible it is not proved that such a phase is present in the materials considered by Brady.

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Deformation and relaxation studies of polycarbonate using the split Hopkinson pressure bar method

Polymers are nowadays employed frequently as construction materials in applications where they are subjected to rapid mechanical deformations. Because polymers are viscoelastic materials they respond appreciably differently when deformed at high rates of strain than when under static conditions. Therefore it is a matter of importance to be able to characterize the dynamical mechanical behaviour of polymers also at high rates of loading.

There is strong evidence that the macroscopic behaviour of polymers during rapid non-linear deformation conditions is intimately related to changes of both static and dynamic microstructure. The dynamic microstructure, which is expressed by molecular relaxations, has been a topic of comprehensive studies [1–4]. It has been shown that the molecular relaxations of polymers contribute strongly to many of the important engineering properties of these materials; for example, ductile–brittle transition [5], yield stress [6, 7], fatigue [8, 9] and impact strength [10, 11]. There are, however, a multitude of open questions which must be solved before the general laws which govern the macroscopic deformation–molecular response relationships of polymers can be formulated. Experimental studies using different measurement methods are therefore important.

In this note, we report that the split Hopkinson pressure bar (HPB) method which has been used in deformation studies of metals [12–14], polymers [15] and composites [16] may also give information about the relaxation behaviour of polymers during compression loading conditions.

The split Hopkinson pressure bar is commonly used in the form reported by Hauser [12], in which a cylindrical test sample is sandwiched between two long steel bars (an elastic input bar and an elastic output bar). The loading is initiated by impacting the input bar with the striker bar, producing a stress pulse whose duration is determined by the length of the striker bar. We have