FEATURES OF THE PERMEABILITY SPECTRA OF $Co_{2-x}Zn_x$ W HEXAFERRITES IN THE SPIN-REORIENTATION PHASE TRANSITION REGION*

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In [1], neutron diffraction studies were carried out, as well as measurements of the anisotropy fields and the initial magnetic permeability of the hexaferrites $Ba(Co_{2-x}Zn_x)Fe_{16}O_{27}$ ($Co_{2-x}Zn_xW$) system. They showed that the spin-reorientation phase transitions (SRPT) such as the easy magnetization axis (EMA) to the easy magnetization plane (EMP) are observed with decreasing temperature from the Curie temperature T_C in the composition range $0 \leq x \leq 1.6$. This transition is due to a change in the sign of the first magnetocrystilline anisotropy (MCA) constant (k_1=0) with a change in the concentration of Zn^{2+} ions or temperature. The transition is carried out through the phase of the easy magnetization cone (EMC).

According to [2], the main contribution to the permeability of hexaferrites in the microwave frequency range is made by the processes of rotation of the magnetization vector. In this case, the observed dispersion of the permeability spectra $\mu^*(f) = \mu'(f) - \mu''(f)$ is related to the resonance in the internal effective field of the MCA. It is called the natural ferrimagnetic resonance (NFMR). Therefore, the concentration and temperature dependences of the permeability spectra of hexaferrites $Co_{2-x}Zn_xW$ system should also have features in the vicinity of the SRPT.

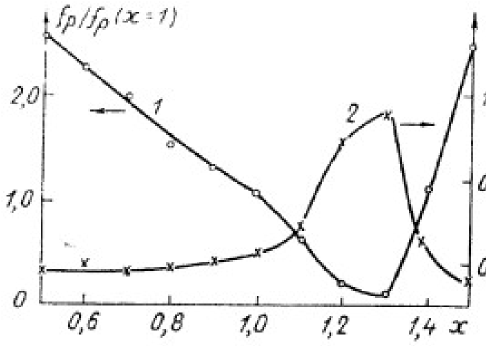

Fig. 1 The concentration dependences of $f_r(x)/f_r(x{=}1.0)$, determined from the maximum of $\mu''(f_r)$ (curve 1) and the dissipation parameter $\alpha(x)$ (curve2). The measurements were carried out at room temperature.

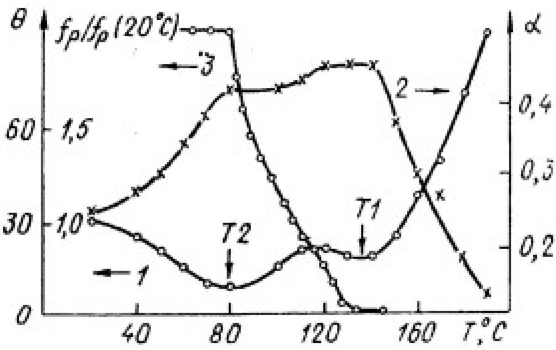

Fig. 2 Temperature dependences the normalized resonance frequency NFMR $f_r(T)/f_r(20\ °C)$ (curve 1) and $\alpha(T)$ (curve 2) of hexaferrite CoZnW (x=1). Curve 3 is the calculated from the neutron diffraction data in [1] temperature dependence of the angle of easy magnetization direction of a given hexaferrite.

An experimental study of the $\mu^*(f)$ spectra was carried out on polycrystalline samples synthesized using a two-stage ceramic technology. The content of the main W phase in the materials was not less than 90 %, the density of the samples was not less than 0.8 of the x-ray density.

Neutron diffraction studies hexaferrites $Co_{2-x}Zn_xW$ system [1] showed that up to concentrations $x \leq 1.2$ there is an EMP at room temperature. EMC is realized for ferrite with $x_c = 1.3$. Materials with $x \geq 1.38$ have EMA. Thus, observed in the dependences $f_r(x)/f_r(x{=}1.0)$, and $\alpha(x)$ anomalies are related to SRPT.

Hexaferrite CoZnW (x=1) up to a temperature T_2 = 80 °C, has EMP phase according to neutron diffraction studies (curve 3 in Fig. 2). Further the easy direction is EMC up to the temperature T_1 = 130 °C, and at higher temperatures phase EMA realized. Fig. 2 shows that the temperatures at which $f_r(T)/f_r(20\ °C)$ passes through the minimum are in good agreement with the temperatures of the SRPT EMP to EMC (T_2) and EMC to EMA (T_1) on the curve 3. The damping constant α is maximum in the interval of the conical phase and rapidly decreases outside the SRPT region. Thus, a change in the concentration of zinc ions allows a wide variation in the frequency of NFMR.

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