$$\sigma_s^{-1}\left(\frac{\partial\sigma_s}{\partial p}\right)=\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)-\frac{1}{3}K+\frac{1}{4\pi q-NA}\left[\frac{2}{3}KNA+N\frac{\partial A}{\partial p}+A\frac{\partial N}{\partial p}\right]. \quad (5)$$

Comparing Eq. (5) with (3), not only the pressure coefficiet of Φ_s' is replaced for that of Φ_s, but also the 3rd term is added to the right-hand side.

In the present measurement, the coil is placed outside of the pressure bomb, so that it is unaffected by an applied pressure. Accordingly, as the 2nd term $\partial A/\sigma p$ in the brackets in Eq. (5) is zero, Eq. (5) reduces to

$$\sigma_s^{-1}\left(\frac{\partial\sigma_s}{\partial p}\right)=\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)-\frac{1}{3}K+\frac{1}{4\pi q-NA}\left[\frac{2}{3}KNA+A\frac{\partial N}{\partial q}\right]. \quad (6)$$

After rearranging the 3rd term in the bracket, the pressure coefficient of σ_s in the present experiment can be expressed as

$$\sigma_s^{-1}\left(\frac{\partial\sigma_s}{\sigma p}\right)=\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)-\frac{1}{3}K+\frac{1}{3}KC, \quad (7)$$

where C is a constant determined from the dimension of the specimen and the coil given.

Even if the dimensions of the specimen and the coil are changed in the present measurement, Eq. (7) will be generally accepted, but the value of C must be changed. The analytical estimation of C appears difficult except for an ellipsoidal specimen. The value of C, however, can be experimentally obtained in the following way.

In Eq. (7) the correction term $(1/3)KC$ can be neglected, if the specimen used has a large dimension ratio and the measurement can be done in a solenoidal coil. The pressure coefficient of σ_s is therefore obtained from

$$\sigma_s^{-1}\left(\frac{\partial\sigma_s}{\partial p}\right)=\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)_{sol.}-\frac{1}{3}K, \quad (8)$$

where the suffix sol. denotes that $\partial\Phi_s'/\sigma p$ is observed under the condition just mentioned. In the measurement the magnetically soft material is desirable for the specimen, because the solenoidal coil is used which hardly produces a high field.

Tange[17] has made the measurement in the solenoidal coil on magnetically soft material such as 24 at.% Cu-Ni alloy, and proved that Eq. (8) was available for a specimen of 75 mm in length and 5.5 mm in diameter, and a search coil of 13 mm in length and 22 mm in effective diameter.

In the present measurement, the dimension ratio of the specimen is small, so that Eq. (8) is unavailable. Substracting Eq. (8) from (7), the following relation is obtained

$$\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)_{sol.}-\Phi_s'^{-1}\left(\frac{\partial\Phi_s'}{\partial p}\right)_{mag.}=\frac{1}{3}KC. \quad (9)$$

Here the suffix mag. is used for $\partial\Phi'_s/\partial p$ in Eq. (7) and denotes the observation in an electromagnet with a specimen as in the present measurement. Equation (9) is generally accepted for obtaining the correction term $(1/3)KC$ experimentally, since C is theoretically independent of the saturation magnetization M_s of the specimen employed. Here it is noted that both $\Phi_s'^{-1}(\partial\Phi'_s/\partial p)_{\text{sol.}}$ and $\Phi_s'^{-1}(\partial\Phi'_s/\partial p)_{\text{mag.}}$ are dependent on the material of the specimen.

In the actual determination of the constant C in Eq. (9), Cu-Ni alloys have been employed, because some data of the relation between the apparent demagnetizing field and the dimension ratio of specimen and coil have already been obtained in the measurement by Tange. The determination of C has been made at $-73°C$ on the three specimens, 13, 18 and 24 at. % Cu-Ni alloys, so that a reliable value of C could be obtained as an average. The result showed that C was independent of the saturation magnetization M_s of the specimen employed as theoretically expected. The reason why the measurement was done at $-73°C$ is that the most stable measurement could be made at the temperature. The value of C thus obtained is 0.73 ± 0.03.

As referred to in section 1, many investigators have measured the pressure effect on Φ_s and some of them will be briefly reviewed from the view point of the apparent demagnetizing field caused by free poles appearing at both the ends of the specimen. Ebert et al.[5] have measured in the electromagnet and set the coil outside of the pressure bomb. The effective diameter of the coil was larger than that of the specimen and also the length of the specimenwas relatively short, but he was not careful of the apparent demagnetizing field. Knodorskii et al.[7] have measured in the solenoid and the specimen was 112 mm in length and 5.9 mm in diameter, respectively. Therefore, the influence of the apparent demagnetizing field seems to be negligible. Kouvel et al.[9] tried to reduce the demagnetizing field by making the specimen to be a part of the closed magnetic circuit.

Examples and discussions

The pressure coefficient of Φ'_s, $\Phi_s'^{-1}(\partial\Phi'_s/\partial p)$, is obtained from the measurements of $\varDelta\Phi'_s$ and Φ'_s which were described in section 2.

The values of $\varDelta\Phi'_s$ or $\varDelta\Phi'_s/\Phi'_s$ observed at a temperature were almost linear with pressure over the pressures applied. The results for Fe and Ni in ref. (14) are again cited in Fig. 4 as an example. The values of $\varDelta\Phi_s/\Phi_s$ in Fig. 4 are not $\varDelta\Phi'_s/\Phi'_s$ which have been discussed in the present paper, but $\varDelta\Phi'_s/\Phi_s$ in which the necessary correction to Φ_s is not made. The corrected value of $\sigma_s^{-1}(\partial\sigma_s/\sigma p)$ for Fe and Ni obtained from Eq. (7) with the value of C mentioned, is again plotted as a function of reduced temperature T/T_c in Fig. 5 which has been previously published.[2]

There is not any remarkable difference between the results in Fig. 5 and those of uncorrected ones[14] except for the absolute value.