absolute values of $\mu_0 H$. Hence, we observe $\bar{\mathbf{M}}$ switching from $\bar{\mathbf{M}} \| -\mathbf{x}$ (first e.a., parallel to $\mathbf{H}$) to $\bar{\mathbf{M}} \| \mathbf{y}$ (second e.a., perpendicular to $\mathbf{H}$) and subsequent switching to $\bar{\mathbf{M}} \| \mathbf{H}$ again. Note that the L-MOKE measurement geometry is sensitive only to the projection of $\bar{\mathbf{M}}$ on $\mathbf{H} \| \mathbf{x}$, therefore it is not possible to discriminate between the energetically degenerate $\bar{\mathbf{M}}$ orientations $\Theta = 90°$ and $\Theta = 270°$.

Having determined $\Theta(H)$, we can now calculate the magnetoresistance $\rho(H)$ expected in the macrospin model and compare it to four point longitudinal magnetotransport data acquired simultaneously to the MOKE images. The magnetotransport measurements were carried out with the contact geometry sketched in Fig. 1 and a current $J = 5$ mA. The results are shown by the red triangles in Fig. 4(b). The resistivity changes from $\rho_\perp = 734.1$ nΩ m at $\mu_0 H = -30$ mT (negative saturation, $\mathbf{M} \| -\mathbf{x}$) to $\rho_\| = 733.2$ nΩ m at $\mu_0 H = 2$ mT($\mathbf{M} \| \mathbf{y}$) in the magnetic field upsweep. In the following, we take $\rho_\perp$ and $\rho_\|$ as the resistivity for $\bar{\mathbf{M}}$ perpendicular and parallel to $\mathbf{J}$, respectively. The anisotropic magnetoresistance (AMR) $(\rho_\perp - \rho_\|)/\left(\frac{1}{2}(\rho_\perp + \rho_\|)\right) \approx 1.2 \times 10^{-3}$ compares well to the value reported for Co_2MnGe Heusler compounds.[19]

We now calculate the AMR from the effective macrospin $\bar{\mathbf{M}}$ [cf. Fig. 4(a)] using[20]

$$\rho(H) = \rho_\perp + (\rho_\| - \rho_\perp)\cos^2[\Theta(H) + \Phi], \quad (2)$$

where $\Phi = 270°$ is the angle between the current direction $\mathbf{J}$ and the $\mathbf{x}$-axis. The result is depicted by the open circles in Fig. 4(b) and shows excellent agreement with the AMR determined by magnetotransport measurements. This shows that, in Co_2FeAl Heusler compounds, it is possible to model the AMR using a simple macrospin model that neglects the domain wall resistance, although microscopically a complex domain pattern is observed (cf. Fig. 2).

In conclusion, we compared magnetic microstructure and magnetotransport properties in Co_2FeAl Heusler compounds by simultaneously recording spatially resolved magneto-optical Kerr effect and magnetotransport data. An effective magnetization orientation (macrospin) corresponding to the spatially averaged microscopic $\mathbf{M}$ configuration in the region probed by magnetotransport was extracted from the MOKE images. We found that the magnetotransport properties can be quantitatively reproduced assuming that this macrospin determines the magnetoresistance. This demonstrates that even if the investigated Heusler microstructure exhibits a complex magnetic domain pattern, a macrospin model fully suffices to describe its magnetotransport properties. Hence, the contributions of domain walls to the magnetoresistance are negligible. This opens the path for further investigations of Heusler compound thin films, using macrospin-based magnetotransport techniques.

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