S1. Tuning the experimental parameters to achieve the well textured Sm-Co hard layer film with high coercivity

We made an effort to get the well-textured Sm-Co hard layer film. The factors that could influence the texture of Sm-Co film such as substrate, deposition temperature and thickness of underlayer Cr, deposition temperature T_{Sm-Co} and sputtering power P_{Sm-Co} of Sm-Co, etc, have been considered. Many experimental conditions have been tried. Finally, we find that MgO substrate, P_{Sm-Co} and T_{Sm-Co} play the important roles in developing the well-textured Sm-Co film with high coercivity. Fig. S1 presents the hysteresis loops of Sm-Co films fabricated at different deposition temperatures. The good squareness of the hysteresis suggests the good texture. It can be seen that the deposition temperature can obviously influence the texture. The best texture is obtained for the film at deposition temperature of 600 ^{o}C. Too lower or too higher deposition temperature will make the texture worse. Fig. S2 shows the hysteresis loops of Sm-Co films fabricated with different sputtering powers for T_{Sm-Co} = 500 ^{o}C. It is interesting to find that the rising of the sputtering powers notably improves not only the texture but also the coercivity. We further fabricated the Sm-Co films with different powers for T_{Sm-Co} = 600 ^{o}C (see Fig. S3). Indeed, the increase of sputtering power can significantly increase the texture and coercivity. Surprisingly, an excellent texture is achieved for the film fabricated with $P_{Sm-Co} \geq$ 150 W. We further tried the higher deposition temperatures at the condition of high sputtering power P_{Sm-Co} = 150 W (see Fig. S4). It can be seen that the higher deposition temperatures $T_{Sm-Co} >$ 600 ^{o}C give rise to the lower coercivity and worse texture. Therefore, the optimal experimental conditions to achieve the good texture of the Sm-Co film are $P_{Sm-Co} \geq$ 150 W and T_{Sm-Co} = 600 ^{o}C. This film can help determine the values of H_{ns} and H_{irr} accurately. We think that the high P_{Sm-Co} at certain T_{Sm-Co} will effectively increase the kinetic energy of the sputtered Sm and Co atoms, leading to the significant improvement of epitaxial growth of Sm-Co film on the textured Cr/MgO substrate.

S2. The advantage of the well-textured Sm-Co hard layer film for precisely determining the nucleation field H_{ns} of soft phase.

For comparison, we prepared the Sm-Co(50 nm)/Fe (x nm) on SiO_2 and MgO substrates. Fig. S5 shows the hysteresis loops of these films. The Sm-Co hard layer film on SiO_2 substrate possesses an inferior texture and therefore poorer squareness of the hysteresis loops. It can be seen that the H_{ns} of soft phase can be more precisely determined from the hysteresis loops of well-textured Sm-Co/Fe films on MgO substrate, while that is hardly assessed from the hysteresis loops of Sm-Co/Fe films on SiO_2 substrate owing to the inferior texture and squareness of the hysteresis loops.

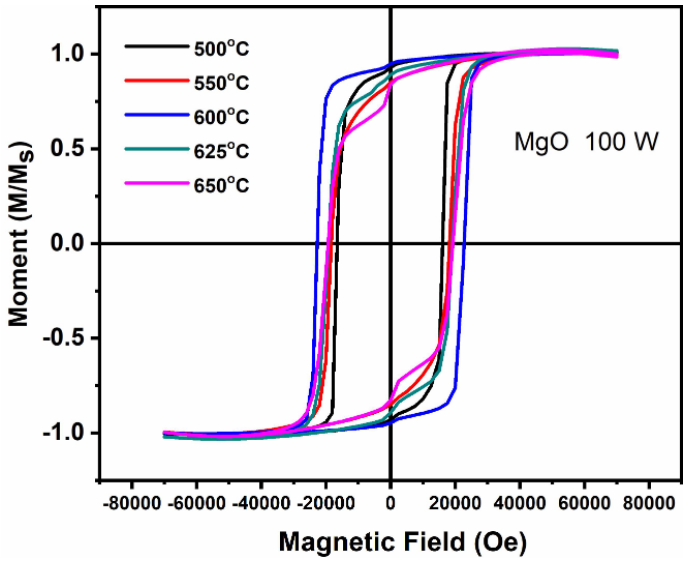

Figure S1:The hysteresis loops of Sm-Co films fabricated at different deposition temperatures.

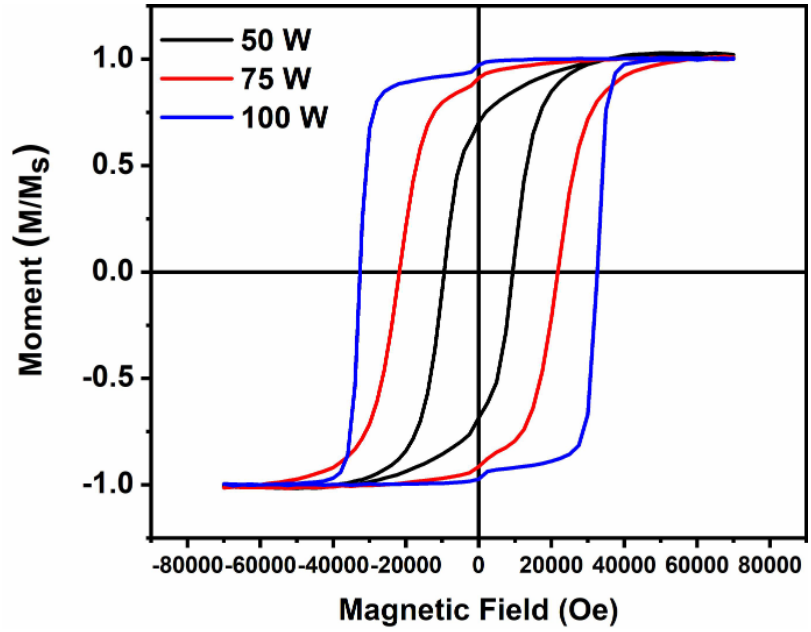

Figure S2: The hysteresis loops of Sm-Co films fabricated with different sputtering powers for $T_{Sm\text{-}Co} = 500\ ^{o}C$.

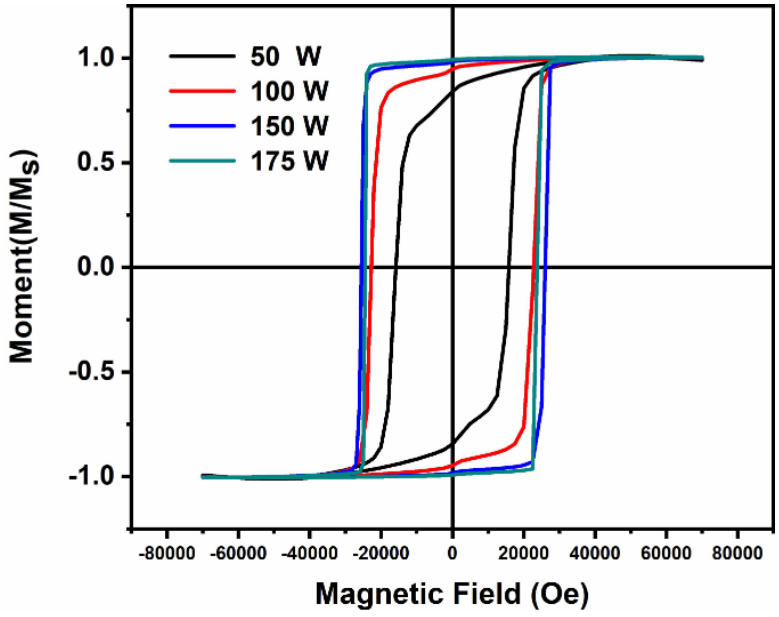

Figure S3:The hysteresis loops of Sm-Co films fabricated with different sputtering powers for $T_{Sm\text{-}Co} = 600\ ^{o}C$.

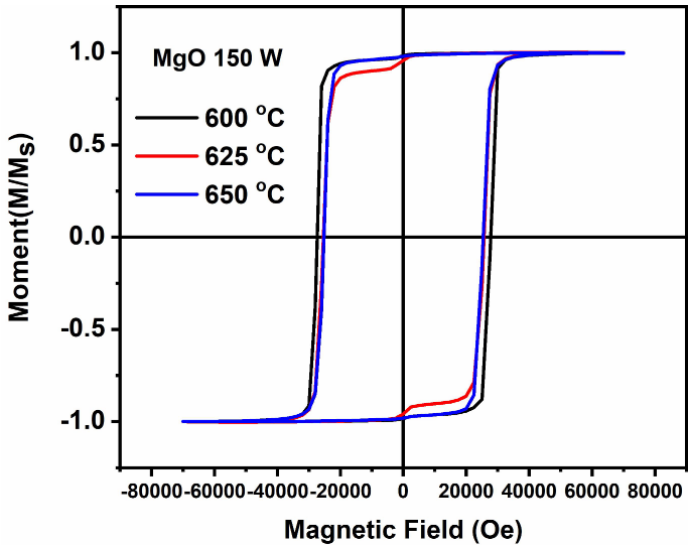

Figure S4:The hysteresis loops of Sm-Cofilms fabricated at higher deposition temperatures $T_{Sm\text{-}Co} > 600\ ^{o}C$

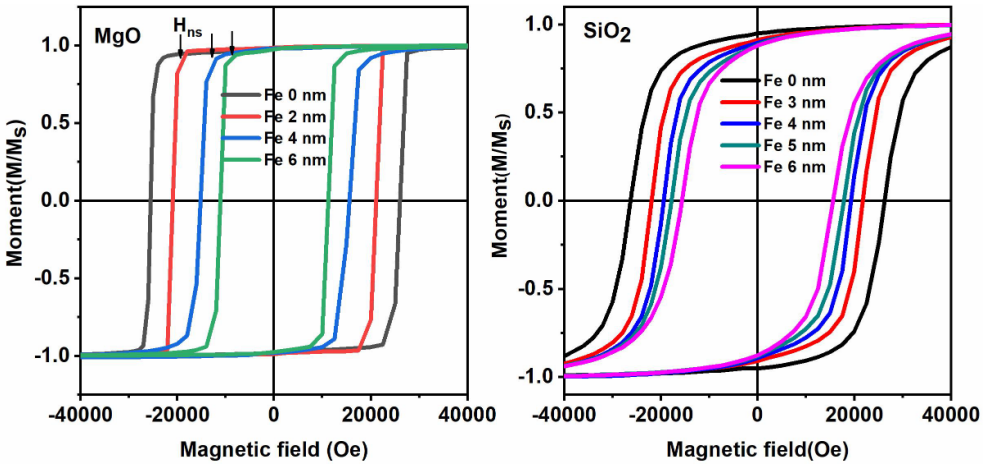

Figure S5: The hysteresis loops of Sm-Co(50 nm)/Fe (x nm) on SiO_2 and MgO substrates.