

# Effects of the Ar pressure on the magnetic and magnetocaloric properties of sputtered Er-Co thin films

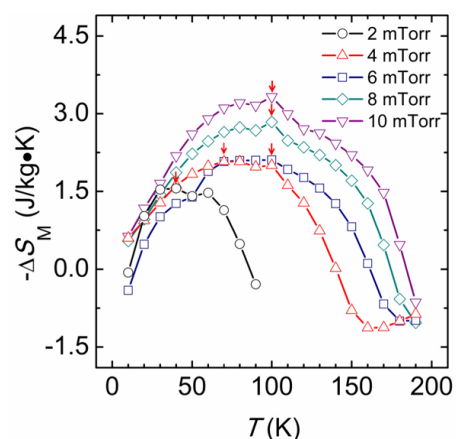
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Due to its eco-friendly characteristics and high cooling efficiency, the magnetic refrigeration utilizing the magnetocaloric effect has attracted a lot of research interests.<sup>1,2</sup> This study deals with the change in the magnetic and magnetocaloric properties of Er-Co thin films as a function of the Ar pressure during sputtering. The thin films with the structure of Ta/Er-Co/Ta were fabricated on a Si/SiO<sub>2</sub> substrate by using a DC magnetron sputtering system. The sputtering conditions were fixed, except for the Ar pressure which was varied widely from 2 to 10 mTorr in steps of 2 mTorr. The amount of Co, relative to Er, decreases with increasing Ar pressure and the specific compositions are as follows: ErCo<sub>1.07</sub>, ErCo<sub>1.04</sub>, ErCo<sub>1.00</sub>, ErCo<sub>0.96</sub>, ErCo<sub>0.93</sub>. All the samples show a good magnetic softness, which can be expected from the amorphous phase in the as-deposited state. The magnetization-temperature curves indicate a typical ferrimagnetic behavior, with the compensation temperature ranging from 83 to 185 K. Considering a small change in composition, this large change in the compensation temperature is unexpected. One possibility can be a large difference in the amorphous structure (such as short-range ordering) depending on the Ar pressure. The results for the temperature dependence of  $-\Delta S_M$  (magnetic entropy change) are shown in Fig. 1. A broad maximum is observed in all the samples. Both the maximum temperature and the absolute value of  $\Delta S_M$  increase monotonically with increasing Ar pressure.



**Fig. 1.** Temperature dependence of  $-\Delta S_M$  under a magnetic field change of 70 kOe for the samples fabricated at different Ar pressures during sputtering.

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## References

- [1] V. K. Pecharsky and K. A. Gschneidner, International Journal of Refrigeration 20, 1239 (2006)
- [2] A. M. Tishin and Y. I. Spichkin, International Journal of Refrigeration 37, 223 (2014)