The influence of substrate thickness on the static and dynamic properties of FeCoB thin films grown onto flexible substrates by the sputtering technique was extensively investigated and the result was analysed based on the Landau–Lifshitz–Gilbert equation. The existence of rotatable magnetic anisotropy was observed and discussed within the framework of ripple theory. It was found that the variation of the rotatable anisotropy field with substrate thickness is roughly coincident with that of coercivity. This suggests that the arising of rotatable anisotropy and the enhancement of coercivity when the substrate thickness is reduced has the same mechanism, i.e., the existence of local random anisotropy. The ferromagnetic resonance frequency is enhanced and the frequency linewidth is broader as the substrate thickness is reduced, which is possibly related to the decrease in the stress in the films. The observed small variation of static permeability with substrate thickness suggests that reducing the substrate thickness is a good way to obtain high effective permeability.