## **Supplementary Information**

Self-assembled Co-BaZrO<sub>3</sub> nanocomposite thin film with ultra-fine vertically aligned Co

nanopillars

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**Figure S1.** Microstructure study of Co-BZO film deposited at 10 Hz. (a) Plan-view STEM image of a selected area of the film, with (b) EDS mapping and (c) atomic-scale high resolusion image of the marked area; (d) Cross-sectional STEM image of a selected area of the film with (e) EDS mapping of the marked area.



**Figure S2** Schematic illustrations to show the growth of Co-BZO thin films: (a) adatom diffusion and cluster nucleation; (b) matrix growth of BZO and pillar generation of Co; (c) complete pillar-in-matrix structure growth.



**Figure S3.** Four low-mag STEM image taken by DF4 detector, used to generate the DPC image by Avizo.



**Figure S4.** Large-scale (a) cross-sectional and (b) plan-view TEM image of Co-BZO nanocomposite film deposited at 5 Hz. Inset is a schematic illustration to show the potential application of this structure as perpendicular magnetic recording (PMR) medium.



**Figure S5.** TEM image of a sample made in another chamber to demonstrate the reproducibility of Co-BZO structure.