Supplemental figures

Figure S1

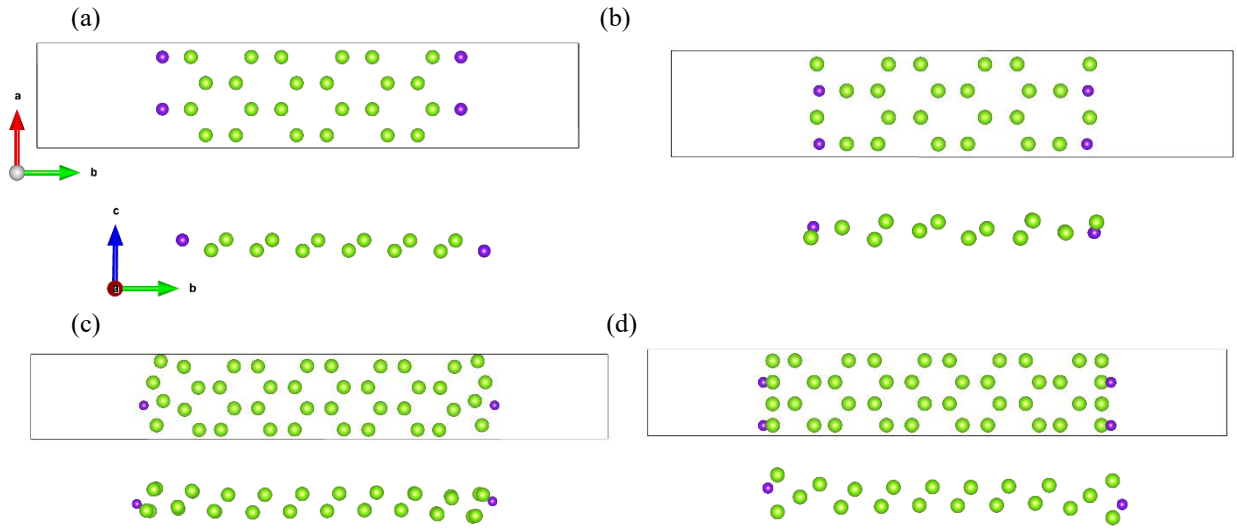

Figure S1: The top and side views of four types of atomic structures obtained for metal-terminated stanene and bismuthene nanoribbons. (a) type 1 for Au- Ag- Cu- terminated stanene and bismuthene ribbons. (b) Fe- Mn- Cr- terminated stanene ZNR as type 2. (c) Ni terminated bismuthene ZNR as type 3 and (c): Mn- terminated bismuthine ZNR ribbon as type 4.

Four different termination configurations were considered for structural relaxation to determine the lowest energy structures. The fully relaxed atomic structures for different terminations are shown in Figure S1. For both stanene and bismuthene with Ag, Au and Cu terminations, the relaxed structures are type 1 (figure S1(a)). The most favorable structure for ZSnNR with Fe, Cr and Mn is type 2 (figure S1(b)). Ni-ZBiNR and Mn-ZBiNR resulted in type 3 and type 4 structures, respectively.

Figure S2

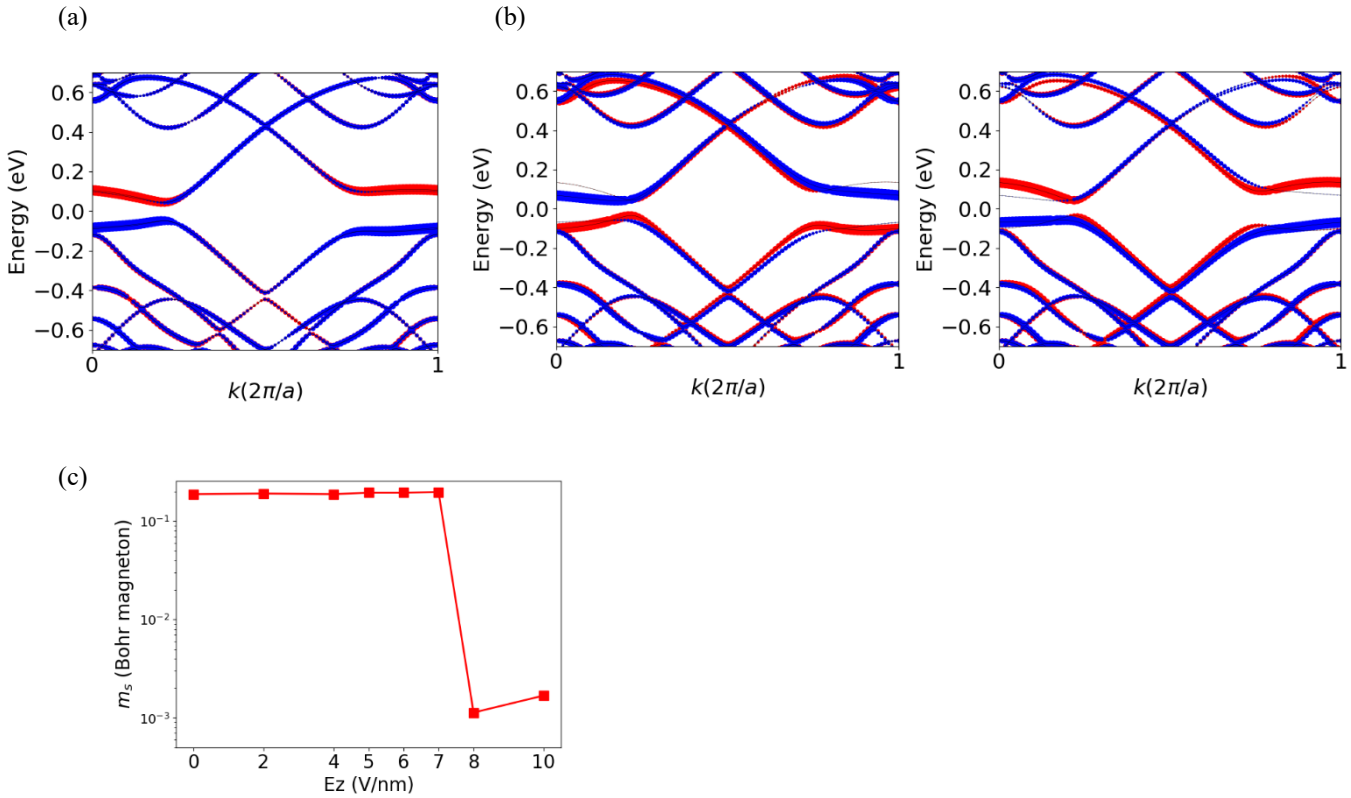

Figure S2 (a) The energy band structure of 2.5 nm wide Ag-ZSnNR with AFM coupling between the two edges. (b) The band structure of Ag-SnZNR with E_z=7 V/nm. The left and right plots show the left and right edge-state spin texture. (c) The local magnetic moment of the edge Sn atom next to the metal atom as a function of an applied electric field in the *z* direction for 2.5 nm wide Ag-ZSnNR.

Figure S2 demonstrates the effects of an applied electric field in the z direction (E_z) on the band structure of a 2.5 nm wide Ag-ZSnNR in AFM state. At E_z <7 V/nm, the gap for one spin slightly reduces (figure S3(b)). The lateral field induces a more pronounced decrease in the energy gap associated with the majority spin (figure 3b in the manuscript). Moreover, the local magnetic moment suddenly drops at Ez=8 V/nm, destroying the antiferromagnetism (figure S2(c)).

Figure S3

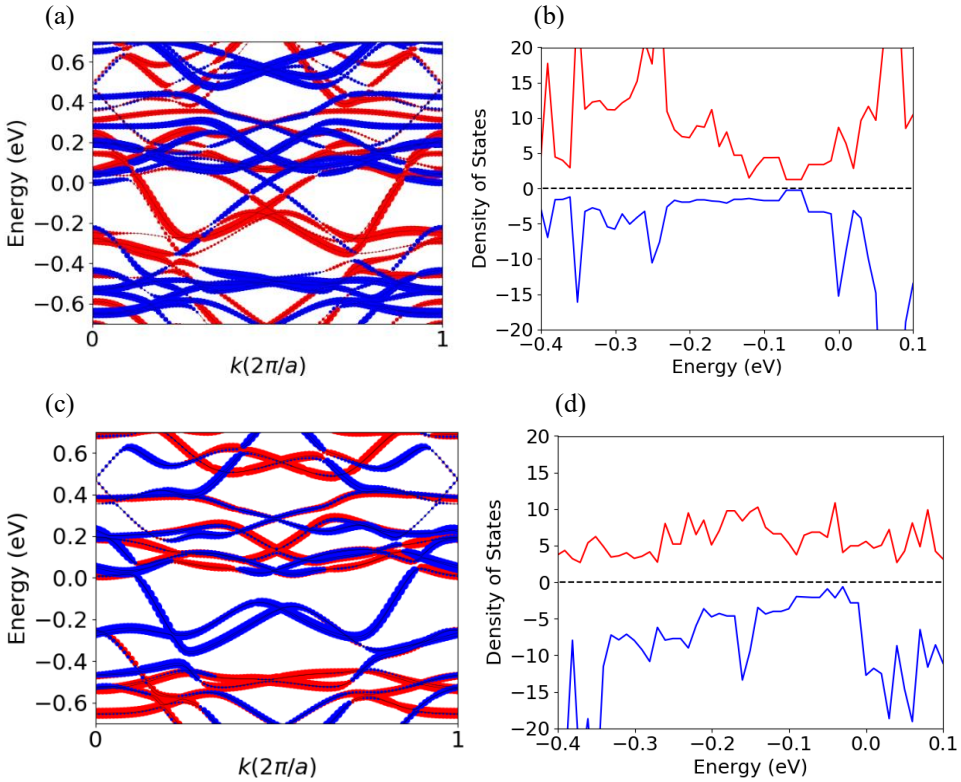

Figure S3 (a) The band dispersion of Fe-ZSnNR in the out-of-plane (OP) FM state. The spin texture is shown by blue and red dots, representing spin-up and spin-down states (b) Spin resolved DoS for Fe-ZSnNR in (a). (c) The band structure for Fe-ZSnNR with OP-AFM coupling. (d) Spin resolved DoS for Fe-ZSnNR in OP-AFM state at Ey=4 V/nm.

The band structure of Fe-ZSnNR is shown in figure S3 for both FM and AFM exchange couplings. The band dispersion shows significant change and noticeable spin polarization in states slightly below the Fermi level. In AFM case, the spin degeneracy is still preserved (Figure S3(c)). By introducing a transverse electric field, spin degeneracy is lifted. Figure S3(d) shows the spin resolved DoS for the structure under Ey=4 V/nm, showing a spin polarization in energies just below the Fermi level. Similarly, Cr- and Mn- terminated ribbons showed noticeable spin polarization.