Electronic Supplementary Information

Intrinsic Quantum Spin Hall and Anomalous Hall Effect in *h*-Sb/Bi Epitaxial Growth on Ferromagnetic MnO_2 Monolayer

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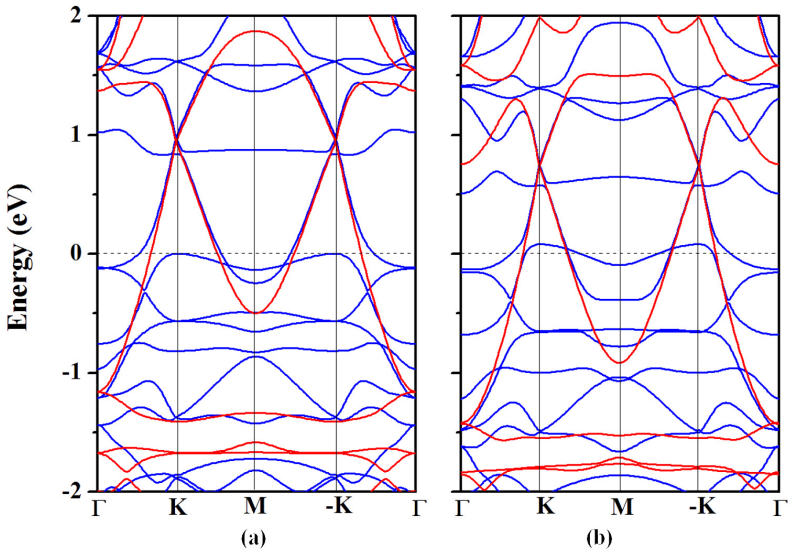

Figure S1. Spin polarized band structure of (a) *h*-Sb@MnO_2 and (b) *h*-Bi@MnO_2 with blue and red colors representing spin up and spin down channels, respectively. The Fermi level is shifted to 0 eV. One clearly sees that Dirac points at the K (–K) decrease from 0.96 and 0.74 eV, respectively.

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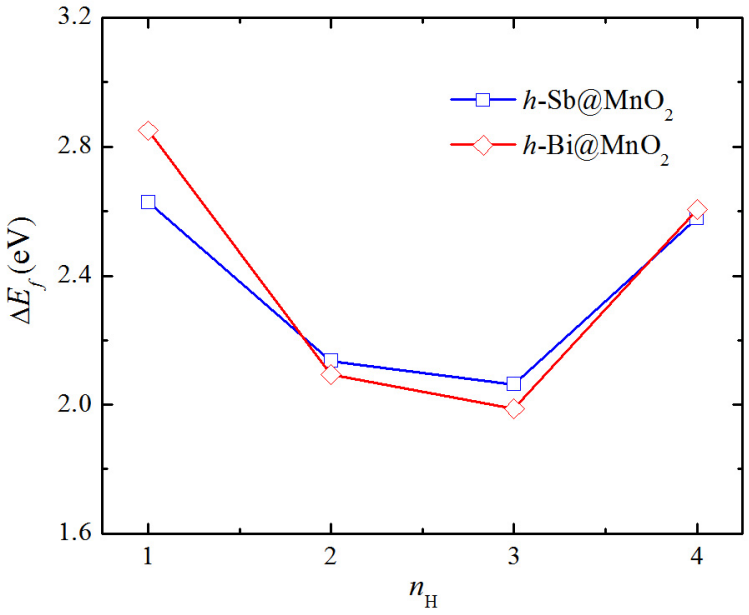

Figure S2. Variation of formation energy (see main text) with respect to absorbing H atoms.

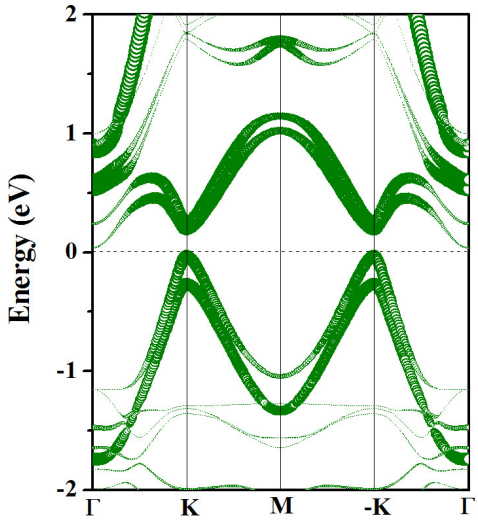

Figure S3. Band structure (with SOC) of *h*-Sb@MnO_2-4H with circle size denoting Sb-p_x,p_y contribution.

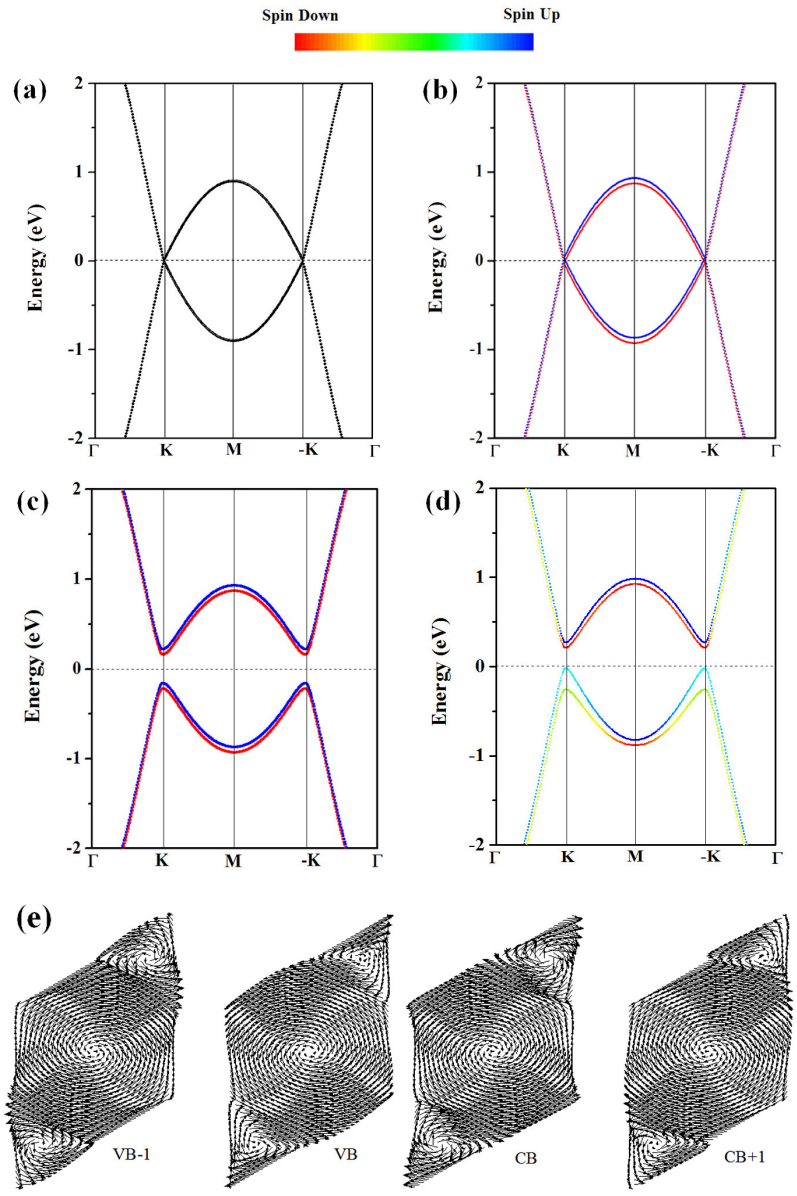

Figure S4. Band structure calculated using the tight binding model (see main text for the Hamiltonian). (a) Only hopping integral. t = 0.91 eV, M_{ex} = λ_{in} = λ_R = 0. (b) Hopping integral and magnetic exchange. t = 0.91 eV, M_{ex} = 0.03 eV, λ_{in} = λ_R = 0. (c) Hopping integral, magnetic exchange, and intrinsic SOC. t = 0.91 eV, M_{ex} = 0.03 eV, λ_{in} = 0.016 eV, λ_R = 0. (d) Hopping integral, magnetic exchange, intrinsic and Rashba SOC. t = 0.91 eV, M_{ex} = 0.03 eV, λ_{in} = 0.016 eV, λ_R = 0.027 eV. Different colors in (b)-(d) represent $\langle \hat{s}_z \rangle$. (e) In-plane spin texture of four bands. We observe that the spin textures at the K (and –K) calculated from the tight binding model have similar behavior with those calculated from DFT, validating our tight binding model.

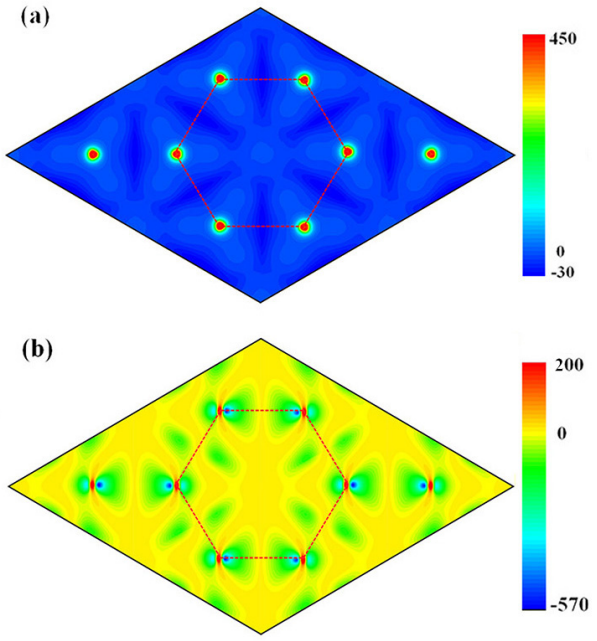

Figure S5. (a) Berry curvature and (b) spin Berry curvature between CB and CB+1 [denoted as $\Omega_{CB}(\mathbf{k})$ and $\Omega^{s}_{CB}(\mathbf{k})$] of *h*-Sb@$MnO_2$-4H.

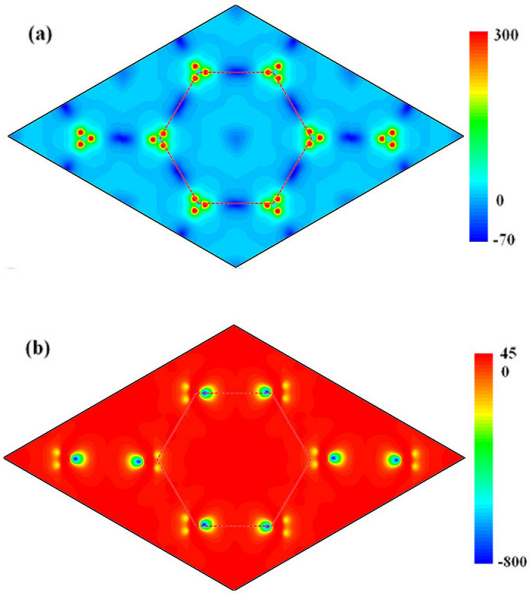

Figure S6. (a) $\Omega_{CB}(\mathbf{k})$ and (b) $\Omega^{s}_{CB}(\mathbf{k})$ of *h*-Bi@MnO_2-4H.