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Competition mechanism of self-trapped excitons and Te^{4+} ions emission in Te^{4+} doped vacancy-ordered double perovskite Rb_2HfCl_6 and its excellent property

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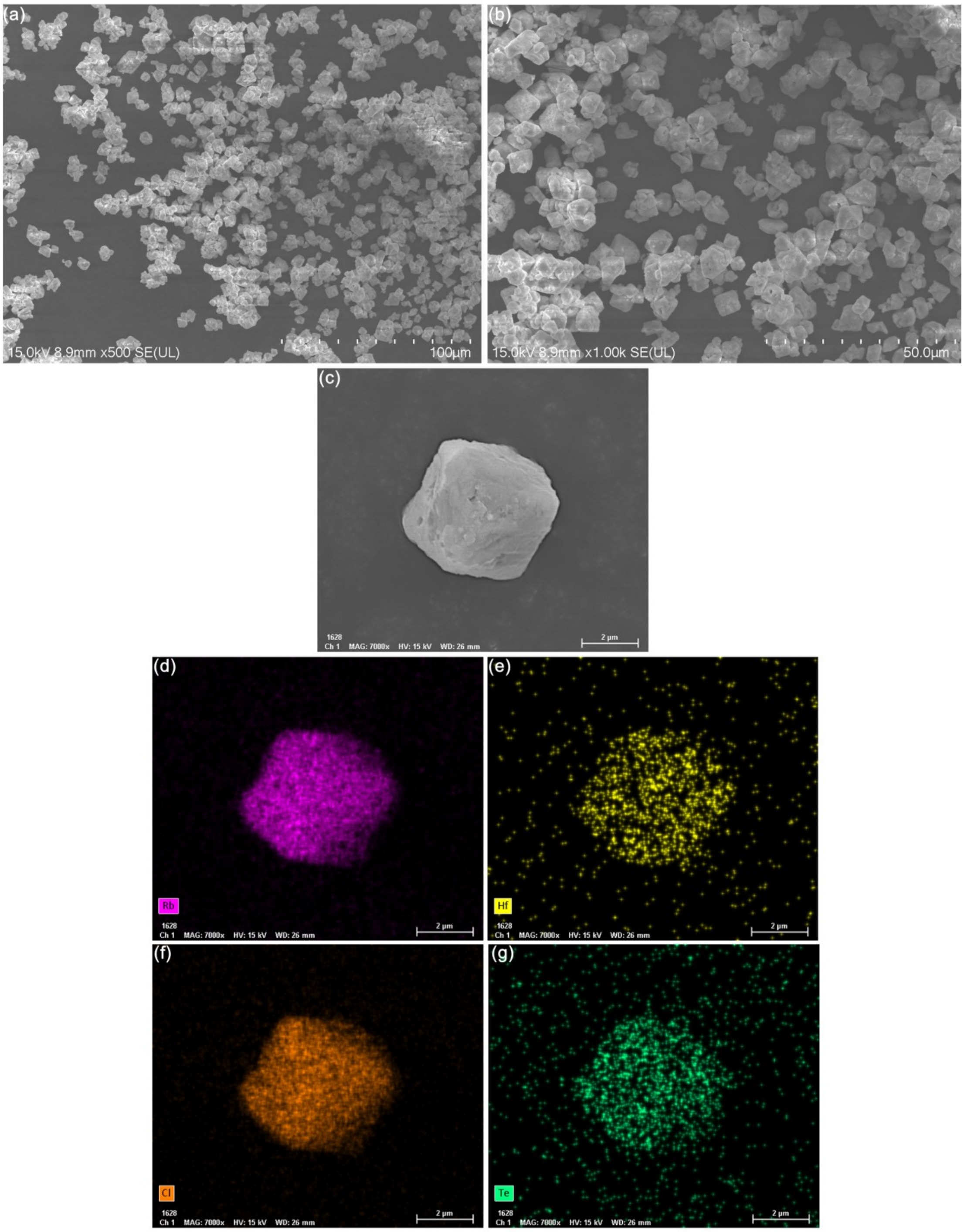

Figure S1. (a,b) SEM images of Rb_2HfCl_6: 3%Te^{4+}VODP; (c-g) EDS element mapping image for Rb_2HfCl_6: 3% Te^{4+}.

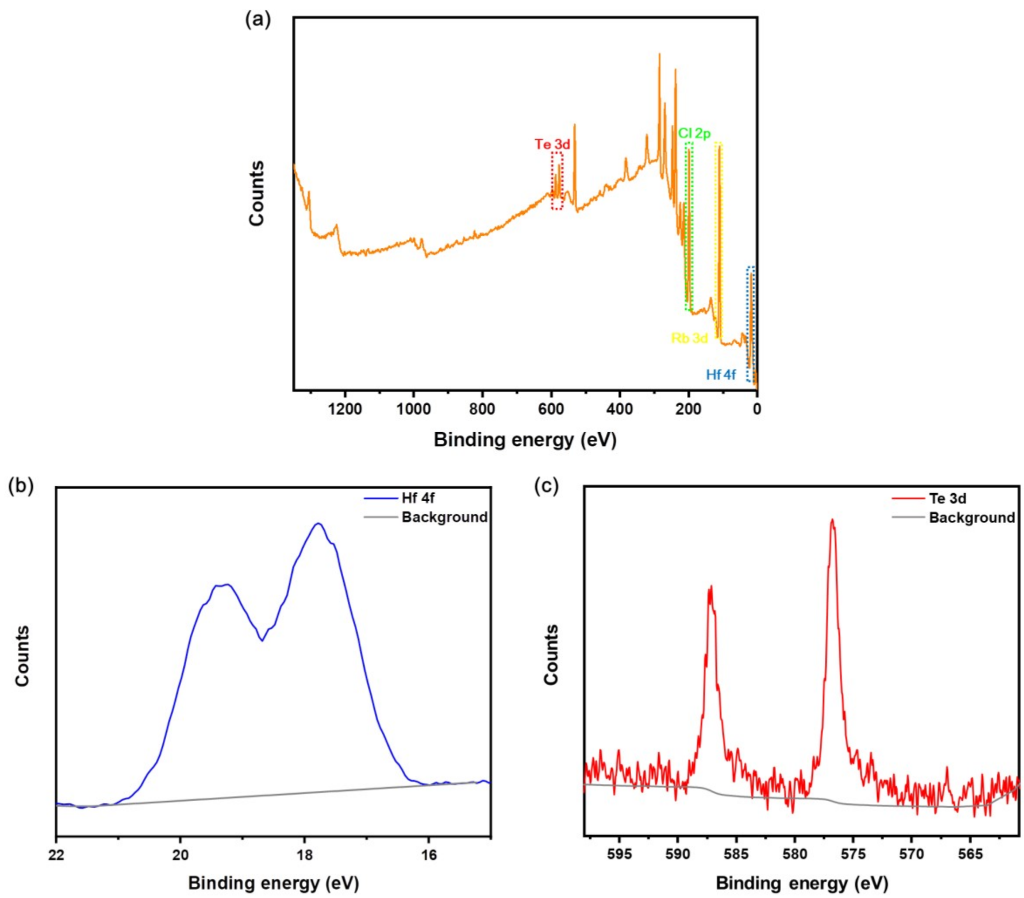

Figure S2. (a) XPS spectrum of Rb_2HfCl_6: 3%Te^{4+}VODP; High resolution XPS spectrum of (b) Hf 4f and (c) Te 3d.

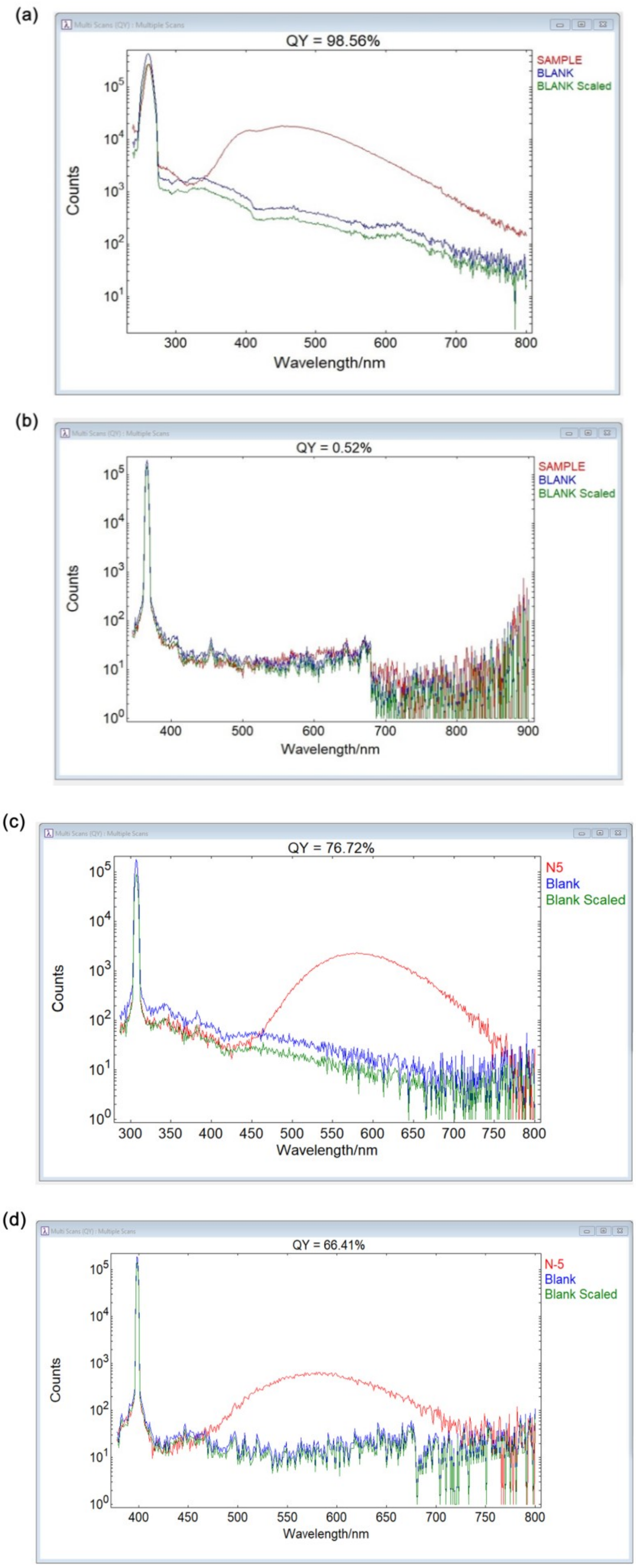

Figure S3. PLQY measurements of (a) Rb_2HfCl_6 and (b) Rb_2TeCl_6; PLQY measurement of Rb_2HfCl_6: 3%Te^{4+} at excitation wavelengths of (c) λ_{ex} = 306 nm and (d) λ_{ex}=398 nm.

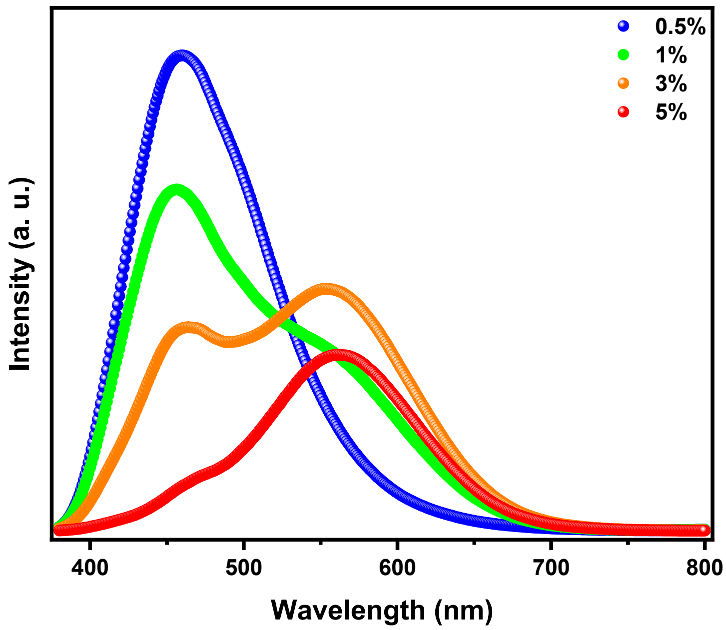

Figure S4. PL spectra of Rb_2HfCl_6: x%Te^{4+} excited by 251 nm (x=0.5, 1, 3, and 5).

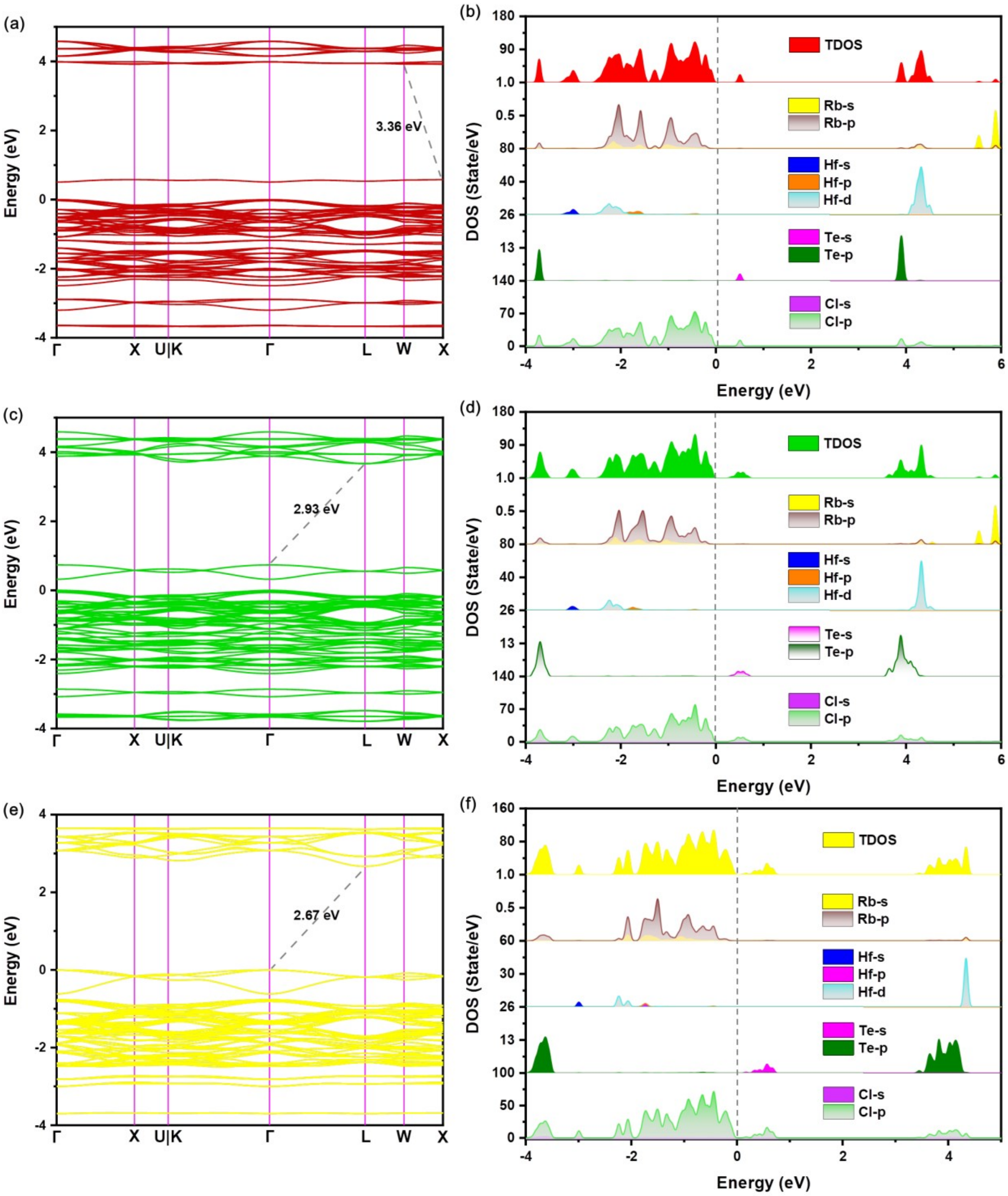

Figure S5. (a) Electronic band structure and (b) DOS of Rb_2HfCl_6: 25%Te^{4+}; (c) Electronic band structure and (d) DOS of Rb_2HfCl_6: 50%Te^{4+}; (e) Electronic band structure and (f) DOS of Rb_2HfCl_6: 75%Te^{4+}.

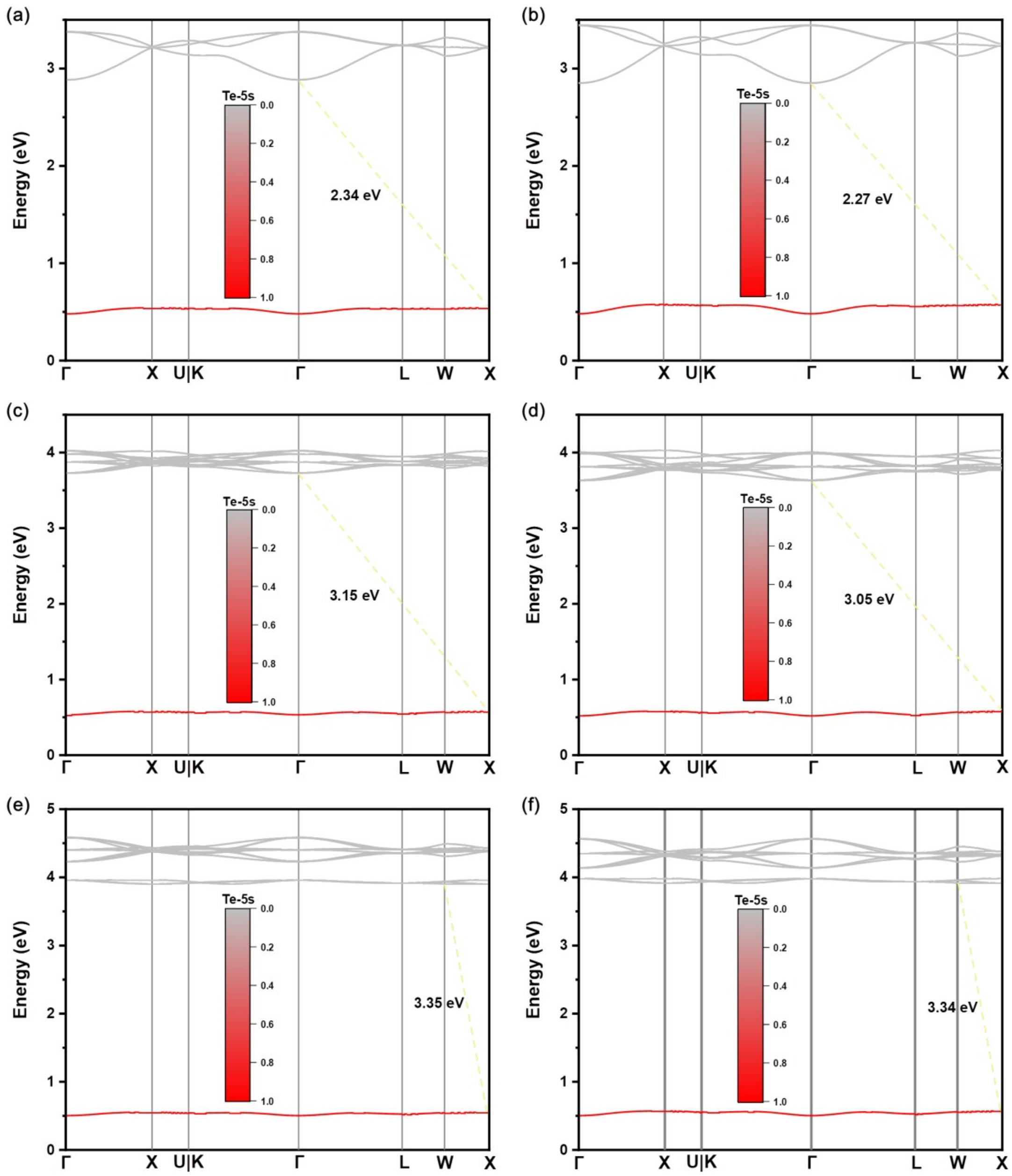

Figure S6. Te-5s orbital projection energy bands of Te-doped (a) Cs_2SnCl_6, (b) Rb_2SnCl_6, (c) Cs_2ZrCl_6, (d) Rb_2ZrCl_6, (e) Cs_2HfCl_6 and (f) Rb_2HfCl_6.

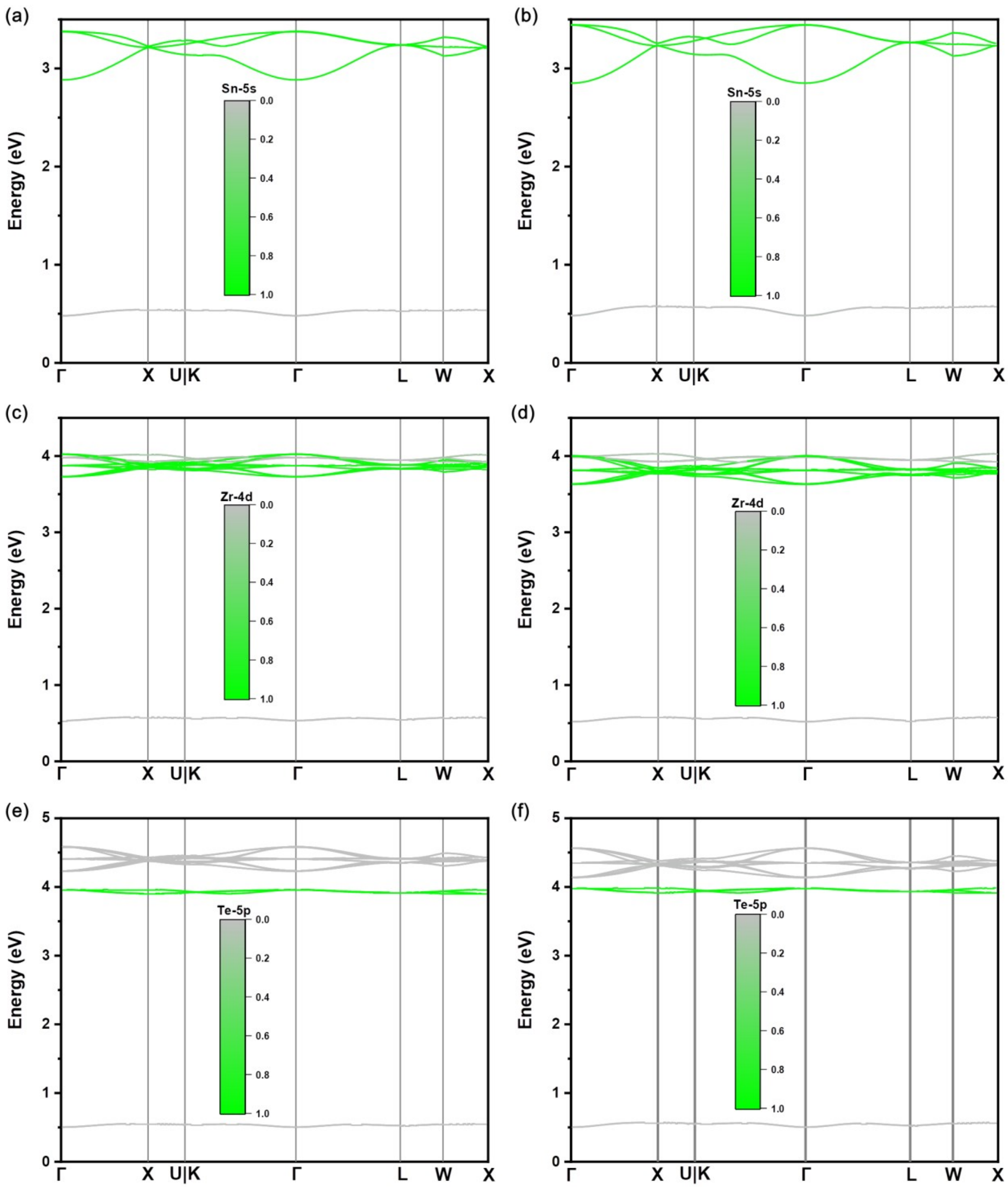

Figure S7. Sn-5s orbital projection energy bands of Te-doped (a) Cs_2SnCl_6 and (b) Rb_2SnCl_6; Zr-4d orbital projection energy bands of Te-doped (c) Cs_2ZrCl_6 and (d) Rb_2ZrCl_6; Te-5p orbital projection energy bands of Te-doped (e) Cs_2HfCl_6 and (f) Rb_2HfCl_6.

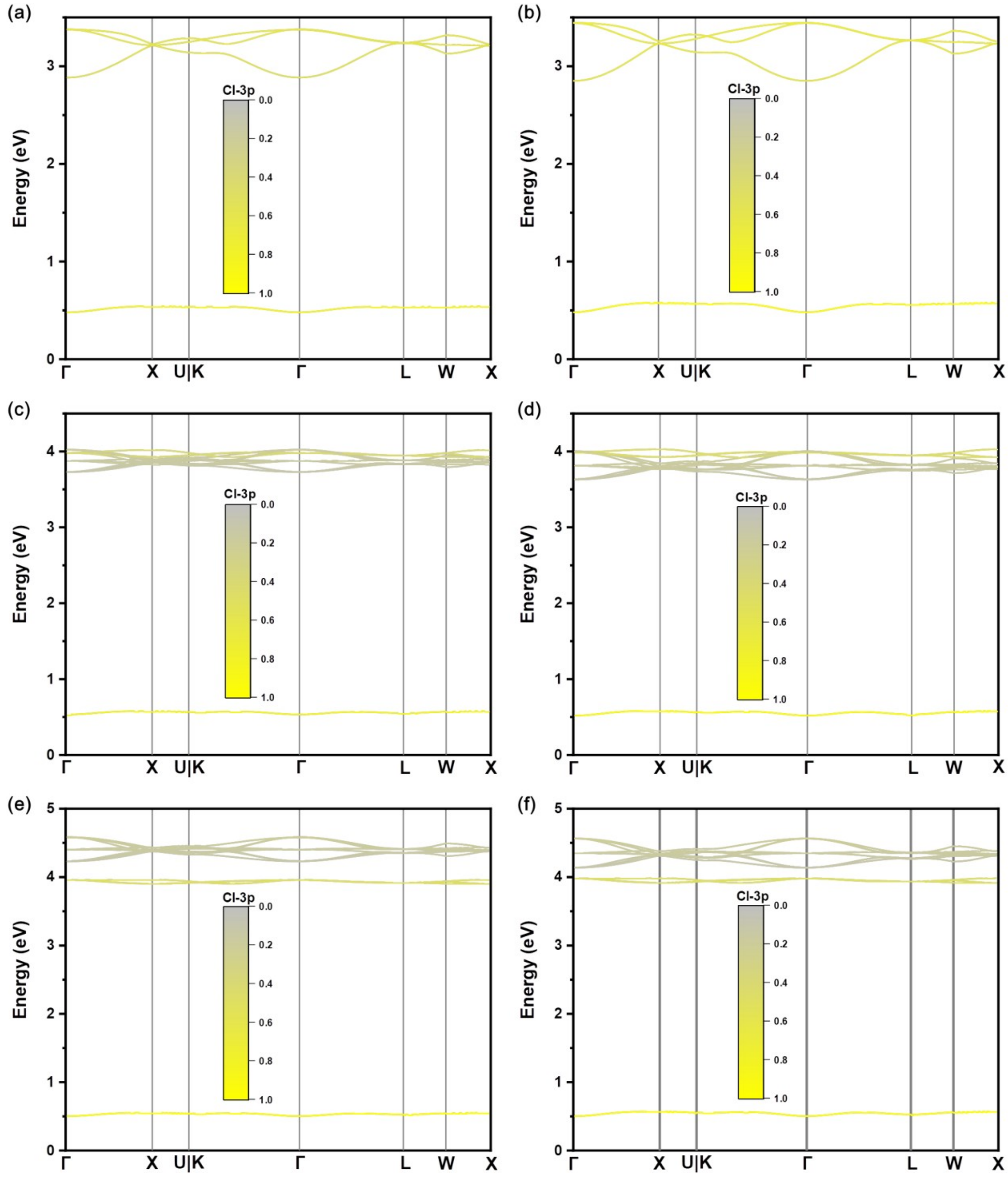

Figure S8. Cl-3p orbital projection energy bands of Te-doped (a) Cs_2SnCl_6, (b) Rb_2SnCl_6, (c) Cs_2ZrCl_6, (d) Rb_2ZrCl_6, (e) Cs_2HfCl_6 and (f)Rb_2HfCl_6.

Table S1. The feed ratio of Rb_2HfCl_6: x%$Te^{4+}$and ICP-OES results.

Feed ratio	ICP-OES results
3%	1.27%
10%	6.74%
25%	19.23%
50%	45.08%
75%	71.61%