supplemental material for

New two-dimensional flat band materials: $B_3C_{11}O_6$ and $B_3C_{15}O_6$

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I. STRUCTURAL EVOLUTION FROM KAGOME TO KAGOME-1 AND KAGOME-2

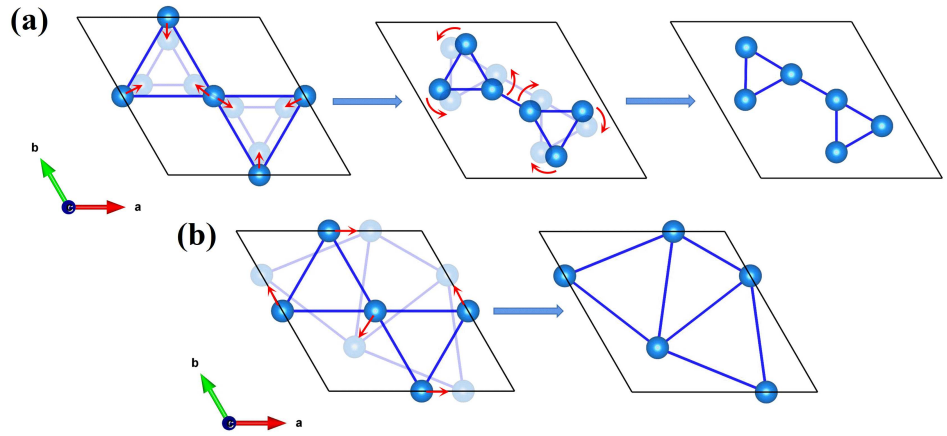

Figure S1: Structural evolution from kagome to (a) kagome-1 and (b) kagome-2.

II. KAGOME-1 AND DISTORTED KAGOME-1 AND CORRESPONDING ENERGY BAND STRUCTURE

Figures S2(a) and S2(b), respectively, are the crystal structures of kagome-1 and distorted kagome-1. Their energy band structures with the parameters of t_1 = -1.0 and t_2 = -1.0 are shown in Fig. S2(c) and S2(d). It is revealed that their energy bands share the similar characteristic of dispersion.

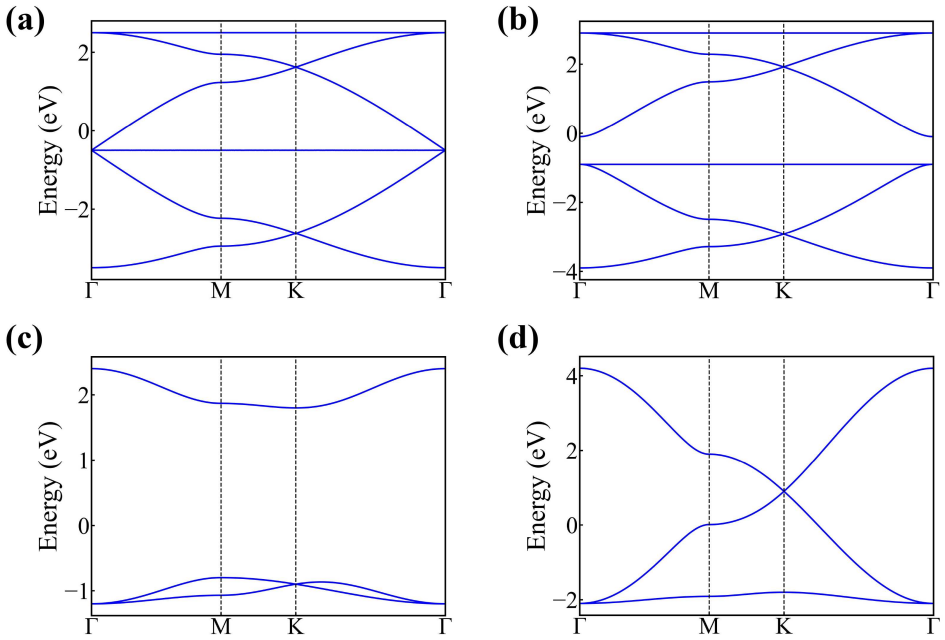

Figure S2: (a) and (b) are two structures of kagome-1 respectively, where t1 = -1.0 and t2 = -1.0. (c) and (d) correspond to their energy bands respectively.

We can obtain three typical energy band dispersions in the kagome-1 lattice by adjusting the parameters t_1 and t_2. The band structure is shown in Fig. 1(e) of the main text when $t_2 < \frac{3t_1}{2}$. Here, we present the band structure at $t_2 = \frac{3t_1}{2}$ and $t_2 > \frac{3t_1}{2}$ in Fig. S3(a) and S3(b), respectively. We provide the band structure for kagome-2 lattice that only takes into account t_1 and t_2. The band structure is presented as two crossed bands and one isolated band with apparent dispersion when $t_1 > t_2$ [see Fig. S3(c)]. However, since the focus of our research is on the flat band's physical characteristics, adding the third nearest neighbor results in a flat band with virtually no bandwidth [see Fig. 1(f) of the main text]. Additionally, the band structure of the kagome-2 lattice is nearly identical to that of the Kagome lattice when we make $t_2 \gg t_1$, as shown in Fig. S3(d).

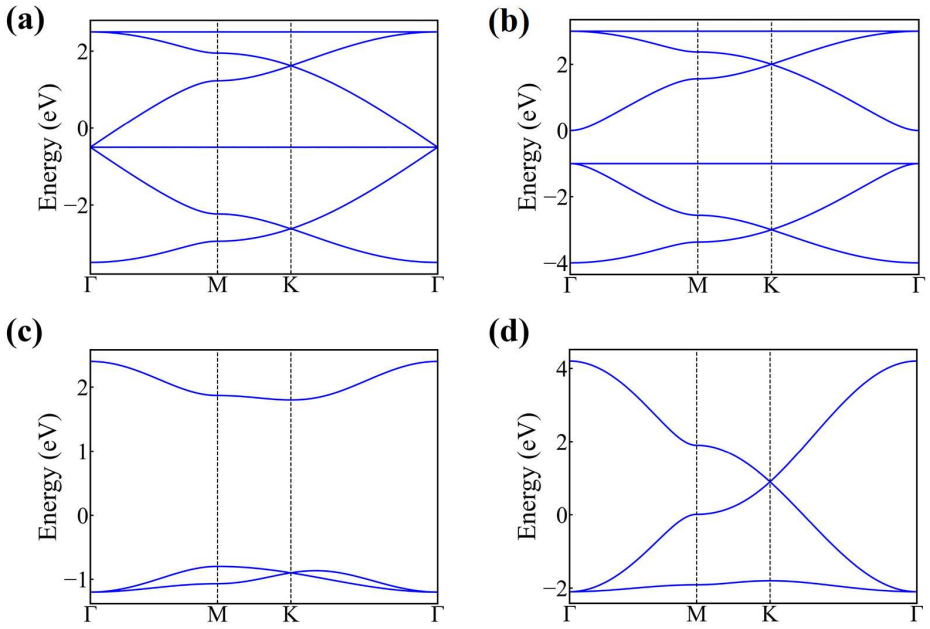

Figure S3: The energy band structure of kagome-1 lattice with (a) t_1 = -1.0 and t_2 = -1.5, and (b) t_1 = -1.0 and t_2 = -2.0. The energy band structure of kagome-2 lattice with (c) t_1 = 1.0 and t_2 = 0.1, and (d) t_1 = -0.1 and t_2 = -1.0.

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