$$H_{ij}(\vec{k}) = \langle i(\vec{k}) | H | j(\vec{k}) \rangle$$

$$= \sum_{\vec{R}_i, \vec{R}_j} \langle i | e^{-i\vec{k}\cdot\vec{R}_i} H e^{i\vec{k}\cdot\vec{R}_j} \underbrace{| j \rangle}_{\text{Wannier}}$$

$$= \sum_{\vec{d}_i, \vec{d}_j} \langle i\, \underbrace{e^{-i\vec{k}\cdot\vec{r}_i}}_{\substack{\text{position of orbital}\\ \text{inside the cell}}} | e^{-i\vec{k}\cdot\underbrace{\vec{d}_i}_{\substack{\text{position}\\ \text{of the cell}}}} H e^{i\vec{k}\cdot\vec{d}_j} \underbrace{| e^{i\vec{k}\cdot\vec{r}_j}\, j \rangle}_{\text{Bloch}}$$

$$= \sum_{\vec{d}_i, \vec{d}_j} \underline{\langle \cdots | H | \cdots \rangle}\, e^{i\vec{k}\cdot(\vec{d}_j - \vec{d}_i)}$$

$$\equiv \sum_{\vec{d}} tt\, e^{i\vec{k}\cdot\vec{d}}$$

$$\begin{cases} \vec{d} = dd^{j}\,\vec{a}_j \\ \vec{k} = k^{j}\,\vec{G}_j \\ \vec{G}_i \cdot \vec{a}_j \equiv \delta_{ij} \end{cases}$$

(i.e. dd^{j}, k^{j} are DIMENSIONLESS)

[ii jj tt dd(1) dd(2) dd(3)]