

## 4.1 The periodic, perfect solid

The description of electronic states within a solid has to take account two competitive tendencies:

1. The perfect crystal shows the periodicity of the lattice and is infinitely large.
2. Defect which control a large number of properties of a solid are localized states.

**Item 1.** can be handled quite easily treating the periodicity of the crystal by the Bloch-Theorem. In this case localized phenomena can only be considered by their (lattice) periodic average.

**Item 2.** can be handled perfectly by standard approaches for molecules, since localized states may be described by only a small number of atoms. The "infinitely large crystal" can not be described in this way, since the capacities of CPU's and memory do not allow for this.

For some applications the approaches 1. and 2. are optimized to such an extend that we find almost identical results for both cases.

But on other fields, e.g. high temperature superconductivity, the coupling of periodical and local components in the model is so strong that until now no approach leads to a satisfying result.