Materials 286C/UCSB: Class I — An overview of crystallography, Crystal systems, Bravais lattices and Miller indices

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There are many ways in which radiation (electromagnetic waves, very small particles *etc.*) and matter interact. The purpose of this course is to understand one class of such interactions – elastic scattering (where the scattered radiation neither gains nor looses energy), in the particular case where the wavelength of the radiation is comparable to the spacings between some periodic structures. As we shall see in the next few classes, periodicity plays a key rôle and the first two classes focus on this. In particular, we will the review the rules of symmetry that govern crystalline structures.

Crystallography

Johannes Kepler recognized in 1611 that the shapes of snow flakes (which are always six-cornered) perhaps reflected the internal arrangement of atoms in the material. He suggested that tiny spheres (of "ice") pack together to form six-cornered objects. Kepler, incidentally, also suggested that fcc packing is the most efficient way of packing spheres of the same size (inspired, we are told, by looking at the way oranges were stacked in the market). The *proof* that fcc packing is the most efficient was provided only in 1998 ($\sim$ 400 y after Kepler). After Kepler, a number of crystallographers, Hooke, Haüy, Barlow, Fedorov *etc.* provided the mathematical basis for crystallography.

Bravais lattices, Crystals systems and Miller indices:

Please see the handout.