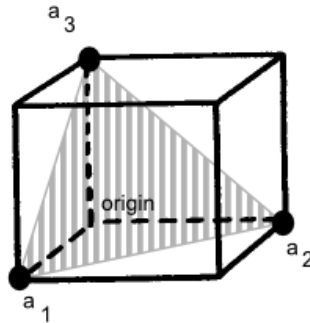


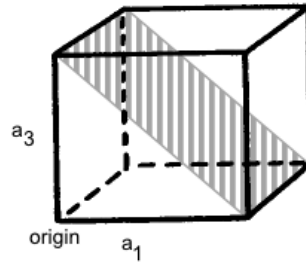
Topic 2-4: Miller Indices
Kittel Pages: 11-12

Summary: This set of notes is an introduction to Miller indices which are used to label planes within different lattices. This labeling is important in things like thin film growth when one needs to see what atoms are at the surface of a material.

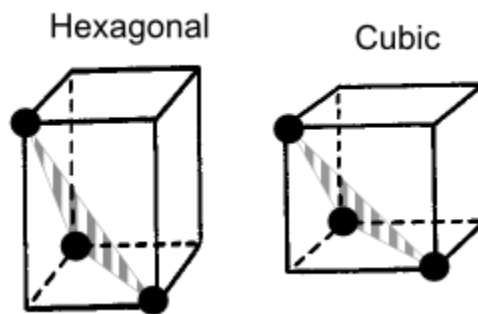
- Need a way to label different families of planes
 - Call notation Miller indices
 - Useful in experimental applications like diffraction and thin film growth
- In order to determine Miller indices we need to invoke that we know the lattice of the crystal
 - E.g. we know that it is hexagonal, cubic, etc.



- This plane has intercepts of $1\vec{a}_1$, $1\vec{a}_2$, and $1\vec{a}_3$
- Taking these intercepts and **inverting** them we get Miller indices of (1,1,1) which are the (h,k,l) values of this plane
- Could also make a plane with intercepts of $2\vec{a}_1$, $1\vec{a}_2$, and $1\vec{a}_3$ with the same axis
- Inverting these gives (1/2, 1, 1) but we want integer values so we scale everything to the smallest integer giving the (1,2,2) plane
- Could also have the (2,4,4) plane and so on and so on
- For this reason we usually label families of planes rather than unique planes



- This plane has intercepts of: $1\vec{a}_1$, $\infty \vec{a}_2$, and $1\vec{a}_3$ because it never intersects with the \vec{a}_2 axis
- When inverting this we get the $(1,0,1)$ plane
- Planes with the same Miller indices will be different for different crystal structures



- The $(1,1,1)$ plane of these two lattice types look different
- For a given crystal lattice the crystal planes are independent of any centering or basis
- One can model crystal structure and planes in VESTA
- This is important for thin film growth as one needs to see what atoms are exposed at the surface