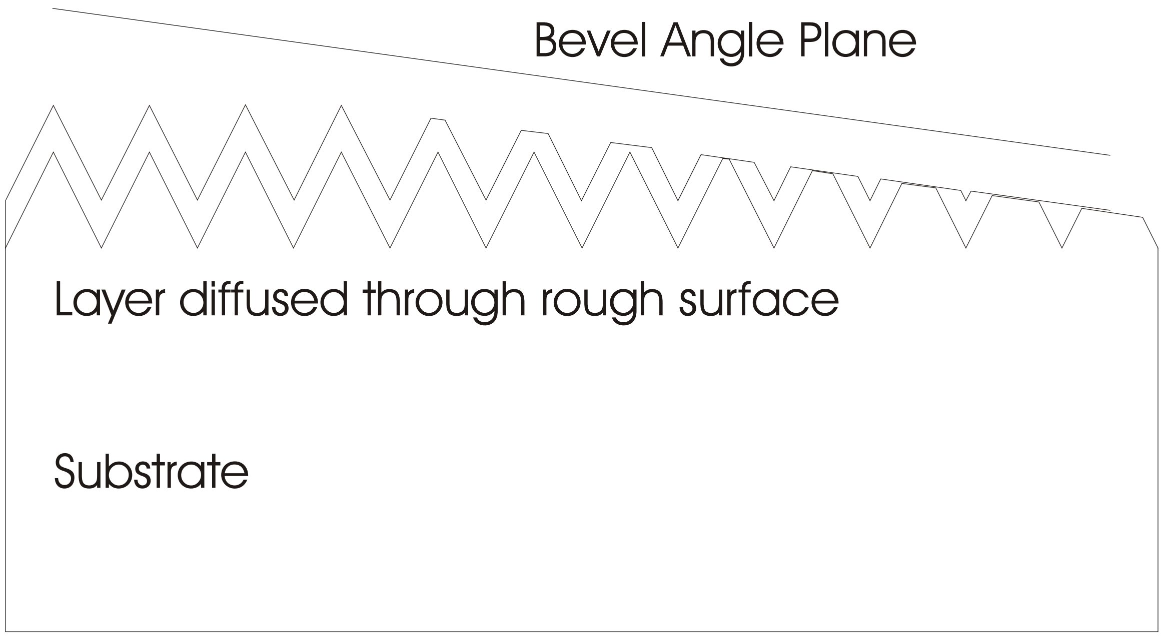
SOLECON LABS TECHNICAL NOTE

Problems with Surface Roughness



Overly simplified illustration of a rough surface having a layer that is half the peak to valley roughness thickness.

There are 12 "peaks" on the example. We have created a bevel on the surface parallel to the plane indicated by the line above the sample. This is done because we need to spread the thickness of the layer(s) into a distance across the surface. Spreading resistance probes have a contact diameter of roughly 2 to 5 microns. They need to step onto unprobed material for reliable readings. Thus the need to spread the layers out across the surface.

The first problem is, where's the bevel edge? In this case we can extrapolate the bevel plane back towards the left and see that it intersects with the top of the 4^{th} peak. So we would want to profile from left to right, starting to the left of the fourth peak. But now we run into our second problem. The initial points off the bevel edge are not really below the surface. It's not until we get close to the 5^{th} peak that we actually drop below the surface. And then we're back to being above the surface again! In this example we run into 8 more bevel edges before we reach the right edge of the sample.

Then we run into the third problem. At the 8^{th} peak, we're starting to reach a depth below the surface where we've reached the junction depth of the surface layer. In the next 4 peaks we go in and out of the surface, surface layer, and substrate regions. In the end we have a collection of resistance values which we cannot convert into valid depth measurements since our data algorithms have no way of knowing the true distance from the surface of any individual reading.

In actual samples, we have peaks and valleys in two dimensions so when one probe is on a peak, the other may be in a valley. And then for the next reading they may trade places. Sometimes the sample's layer thickness is larger than the peak to valley roughness but we still encounter problems until we have reached a depth completely below that surface roughness. In many cases, if the surface layer thickness is over twice the peak to valley roughness, the surface layer junction depth will start rounding out and we can get some meaningful information. Unless we have a mirror polished wafer surface, the values we get for surface readings will always be suspect.

A word about "Undulating Hills" samples. If your samples have an undulating hill roughness we may be able to provide meaningful data however the depth scale uncertainty may be greater than our normal +/-3% since we assume a flat plane for both the bevel and the original surface. After all, we cannot measure the original surface's slope on an area we have beveled away.