DAK.COM®

Sol's Where The Stylus Meets The Groove

Below, using both an Electron Microscope and Metallurgical Microscopes we'll explore how your LP records reproduce sound. Using a stylus's eye view of the groove, we'll better understand how the stylus interacts with your groove and how to keep the interaction at its best from now on. There's a lot more to cleaning and removing static from your LPs than meets the naked eye.

This eBook is like a scrapbook of information about the grooves of your LPs, 45s,and 78s.First we'll explore how records work. Then just below that are the full-size pictures we took with metallurgical microscopes,a scanning electron microscope and even a USB microscope. I won't bother you with many comments.The pictures really do speak for themselves.

Enjoy.. Sol.

How Records Work Where Your Stylus Really Meets The Groove, Really.

Most people don't know where the actual stereo sound tracks are located in the record groove. Out of 100 people most guess the bottom and side of the groove. Actually at the very beginning of Stereo LPs, that was tried. But that presented problems. There was a lot of dirt and debris that bui~ up over time in the bottom of the groove that disrupted that channel. And it was harder for the stylus to follow the hill and dale up and down motion.

So a breakthrough came when they Figured out how to cut the tracks into the grooves so the stylus hit the groove at a 45° x 45° angle. That means that the stylus meets the groove at a 45° angle on each side.

Your stylus never touches the bottom. It rests on the groove walls at what's called the 45° x 45° angle. It reads 1 channel from each side of the groove

And so all modern LP records now use the 45ox45o standard, putting one track on each groove wall. Since records are analog, the actual groove walls carry the exact image of the sound waves or undulations of the music. So if you record a 20,000hz sound, you wi ll get 20,000 waves in the wall per second.

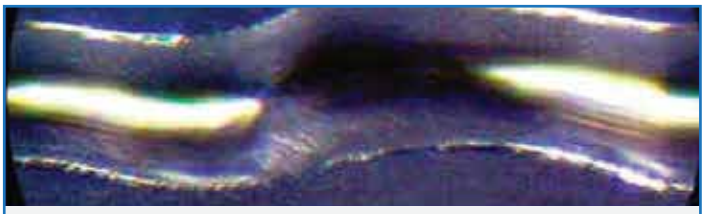
More Complex Side Note: Of course hundreds of waves are all reacting at the same time, but you can best visualize how it works with a single simple wave. And the multiple waves are the same captured waves caught by a microphone, passed down the wire to an amp, recorded on tape and reproduced by speakers. So, cutting a record is just one more step that uses the same identi cal analog sound waves as all other analog devices.

OK back to the groove. It's imperative that the stylus follows these waves on both walls accurately or you won't get the sound you are trying to reproduce. If the intimate contact is broken or impaired by dirt, micro-dust and grime your music will lose detail or you'll hear clicks, pops and ticks.

Remember, that the stylus reproduces anything it hits. If it hits a 200Hz sound, it vibrates 200 times per second. If it hits a micro-dust particle you'll hear a tick. It's all simple physics. It's just that it's all microscopic. And while the concept is basically very simple and was in use as early as 1895 when the 1st groove recordings began, the real critical part is in the execution. And that's where the rubber meets the road or the stylus meets the groove in our case.

Then, there's volume to worry about too. So now we've explored how the notes/frequencies are reproduced. But some are louder and some are softer. How does that work?

Well, it too is simple in concept but difficult in execution. The louder the sound the bigger physically that the waves or undulations have to be. See the concept is simple. Bigger waves in the walls equal louder sound. Also bass frequencies create bigger waves. So Bass and loud volume create deeper waves.



Rub a vallon against your hair and then see how it sticks to the wall. It's the static electicity that makes it cling. And it's the same static electicity that causes dust and dirt that hurts your sound to be drawn to and held on your records.

So here's how we solve the big waves? For volume, we use bigger waves. And when a record is cut, for loud passages, the waves are cut more deeply, bigger, and here's the smart part, the grooves are cut farther apart. Otherwise loud sounds from one track would intrude into adjacent tracks. So bigger waves, wider farther apart tracks. And you can actually see this when you use a microscope.

OK for big bass notes/frequencies, remember how we always remind you about the RIAA Phono equalization? Well what they do when they cut a record is cut the volume/amplitude (fancy word for volume) way back on the bass notes so it doesn't ruin the groove walls by making them so wide they run into adjacent grooves. Then when you play it back, you need to have a phono preamp with the RIAA curve to reverse the bass that they cut back. So that's how you get big massive bass on LPs without running the groove walls into each other. It's simple.

Record's Speed Is A Compromise.

It's always helpful to remember that a record's speed (33-1 /3) is really a compromise between how much music you need to fit on the record and how good you want it to sound.

OK Sol, what the heck does that mean? OK here's the thing. Do you remember recording with open reel tape? We used to call it Reel to Reel tape? I (OAK) used to make tape back in the day, oh about 1968-1980. Anyway, do you remember that you could record at 7 -112" or 3-3/4" inches per second (IPS)?
Weill sure do.

In fact I still have a wall of reels of tape with all the recordings I made in high school and college, before cassettes came into being. Oh, cassettes never sounded as good as open reel tape recordings because cassettes only ran at 1-7/8 inches per second.

Anyway I digress again. So the faster you recorded with tape, the better the sound because you didn't have to squeeze 20,000 vibrations into a small length of tape. So if you went from 3-3/41PS to 7 -1/21PS you got twice the number of magnetic partictes to record your signal. And it sounded a whole lot better. It's the same with records. As the stylus moves along the groove, it can do a much better job of reproducing the musical waves if the record is turning faster, more inches per second. That's why the original records turned at 78RPM.

It's the same with records. As the stylus moves along the groove, it can do a much better job of reproducing the musical waves if the record is turning faster, more inches per second. That's why the original records turned at 78RPM

Record cutters had gotten much better and vinyl was much cleaner than the materials they had available for ok:l78s, so that's how we ended up with 33-1/3. So, most records have about 22-25 minutes per side. If you needed more you would have to turn the record slower, which they did for spoken word at 16-2/3s. But faster would have given even better sound. But everyone agreed on a standard, and 33-1/3 was born.

And it represented a compromise where it was fast enough for good sound reproduction while being slow enough to allow for an acceptable number of minutes of music to be reproduced.

But, not all parts of your LPs are equal. There's 33-1/3 and there's 33-1/3rpm. Everyone thinks 33-1/3 is the speed. But it isn't Records ARE NOT A CONSTANT SPEED ANALOG DEVICE. When you start to play a record at 33-113, at the outside of the LP where the diameter of the record is about 11-1/4" you are actually achieving an Inch Per Second (IPS) Speed at the stylus of about 19.251PS per second. It's n Pi•o (if you've forgotten your junior high math) which is 35 inches. Then since the record is turning at 33-1/3 revolutions per minute, that's about .55 of a revolution per second which makes the inches per second about 19.25 IPS. (35 inches times .55).

But when you get to the center of the Record, where the diameter is only about 5.5", the effective inch per second speed is down to about 9.6 1PS. So using n Pi•o again, we get about 17.25 inches in circumference. Then using 33-1/3RPM which is about .55 of a revolution per second we get to 9.61PS.

So, no matter how good your equipment is, it wi ll always reproduce a record's sound so that the outside part is going to be twice as good as the inside part. And that's a fact. How much of that difference you actually hear is up to your equipment, your speakers and your ears. But the difference is there.

OK, let's take a breath. Now you know how records work. And remember, a clean record will always outperform a dirty record. So when you use OAK's new carbon fiber static draining brush you'll make a significant difference in the sound you hear and if you are using our LP to CD system, the copies you make. Records at their best sound great Records that are dirty, don't.

Why Carbon Fiber Static Electrici Oh My.

Have you ever rubbed a balloon against your hair and then watched your hair stand on end or stuck the balloon to a wall? Static electridty is the build-up of an electri cal charge in an objed. Static electridty causes objects to d ing to each other, like when you take socks out of the dryer. It's called static cling and it's an attraction between two objects with different charges, (+) positive and (-) negative.

Oh and when you rub your feet across a carpet the friction causes a static charge to build up inside of you. You can suddenly discharge this static electricity when you touch a friend (fun) or touch your computer or your records (bad).

Anyway, records are made of vinyl and vinyl pick up large amounts of static electridty. They pick it up when they sit They pick it up when you slide them in and out of the sleeve. And they pick it up when you clean them (but hang on).

Rub a vallon against your hair and then see how it sticks to the wall. It's the static electicity that makes it cling. And it's the same static electicity that causes dust and dirt that hurts your sound to be drawn to and held on your records.

Plus, the very act of playing them, dragging the needle down the groove for 1500' creates static electricity. And why is static electricity bad? It's really bad because it attracts dust, lots and lots of dust, dirt, grime and smoke. Just like when you rub a balloon against your hair and then stick to the wall, a record's charge causes it to become a magnet for dust The beauty of a carbon fiber bush is that it allows the static charge to drain from the record.

Just like when you rub a balloon against your hair and then stick to the wall, a record's charge causes it to become a magnet for dust The beauty of a carbon fiber bush is that it allows the static charge to drain from the record.

In fact, it's electrically conductive and it passes the static charge through the carbon fibers to the aluminum housing to you. Yes, you are part of the drcuit If it's a really dry day, hold onto a metal ground on your turntable or elsewhere or on normal days, your body will absorb the static from 1 or 2 records as you clean them with OAK's all new carbon fiber brush system.

You can see that the meter is pegged all the way at 0 resistance. I have the red prode on the carbon fiber and the black probe on the aluminum case. Now your recorrds will be static free.

Only Carbon Fiber - Just as a test, I bought about 8 different brush and cloth cleaning systems. I won't mention any names. But, not one of these non-carbon fiber brushes or pads or cleaning cloths have any conductivity at all.

Some even have wooden handles that are actually insulators. Even the new micro fiber cloths that can get into the grooves didn't have any conductivity that I could measure. And, I really tried. So get out your VOM and test things yourself like I did. It's really instructive. And it's a ton of fun too.

Oh, one last thought on static because it's so very important If you have a static gun and you don't have a carbon fiber brush, use it for sure. And some of the top record d eaning machines that sell for hundreds of dollars do a good job of both cleaning and removing the static. So the carbon fiber brush isn't the only way. But it's sure the easiest and I think you'll find the best because it's so easy to use as often as you like.

A look Down The Microscopic Rabbit Hole

Sol's Disclaimers and notes

1. These are actual pictures of my records. When you see dirt, that's really the dirt, dust and mucro-dust that really was there. I did not add any dust or dirt at all to these records to make a point. This is really the way my records were. For the dirty record shots I did use a record that I had left out. But unfortunately, that's not unusual for me. But it didn't look bad when I looked at it with the naked eye.

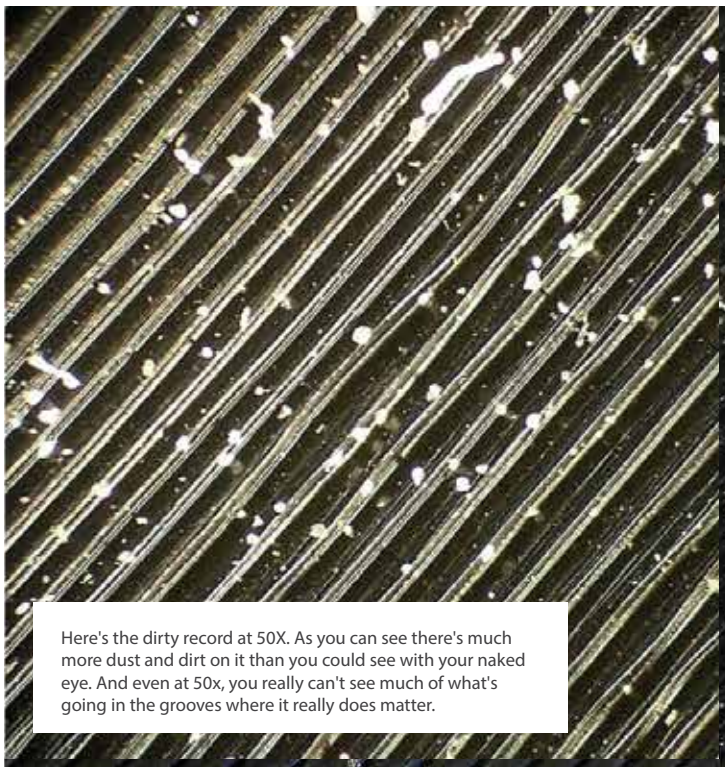
2. These can't really be called true before and after shots for the clean and dirty shots because we had to break the records into tiny pieces to get them under the microscopes. So, even when a shot is from the same record, it's not the exact same groove because there was no way to brush the records after we'd broken a tiny fragment off to put under the microscope. So, while this is what you can expect, ifs not techni cally an NB test because there was no way to really do it.

3. We shot most of the pictures at about 50x 400x and 800x. But you can't say that those magnifications are exact because although they were, when you take microscopic digital pictures and then resize them for the web or my eBook they don't technically stay the same size. For example is your monitor set at 72 or 96dpi and is it set at 1024, 1280 or something else. So you get a really great idea, and in this case size really doesn't matter, what you can see that does matter.

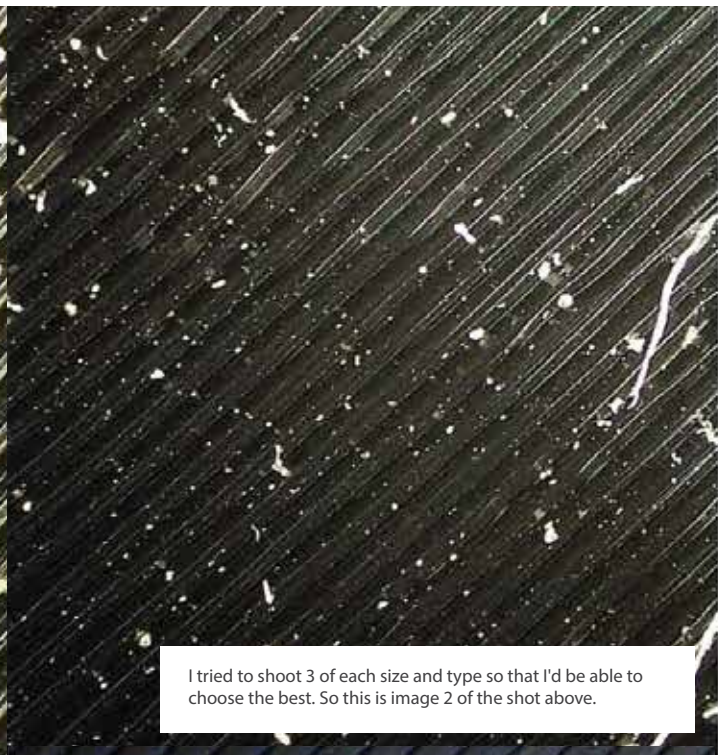
4. Unfortunately records were both hurt and injured during making of these microscopic pictures. But I'd already copied them to my computer using what else, OAK's incomparable LP To CD & MP3 System.
See OAK's LP to CD Svstem here.

OK, Let's Explore.

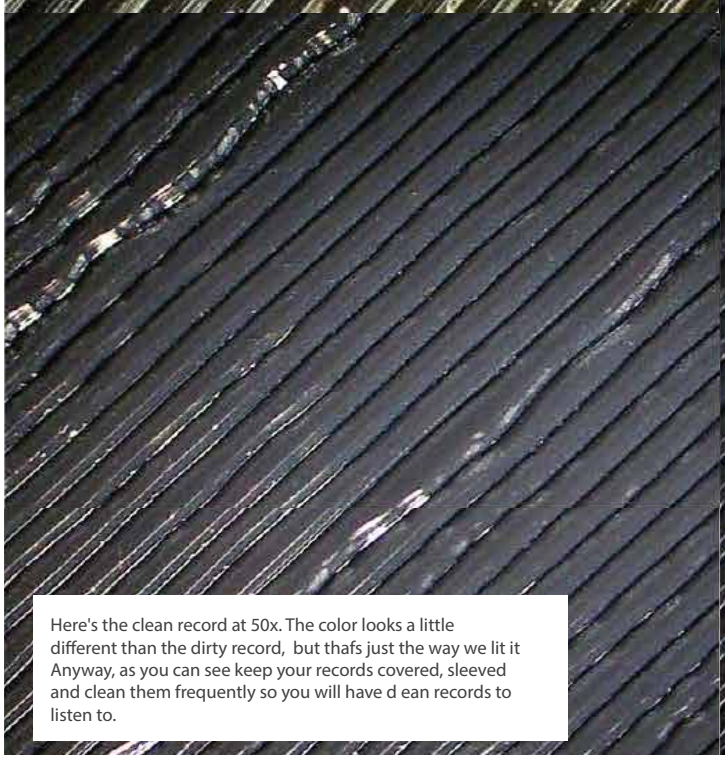
Here's one of my dirty records. As you can see it's not terrible, but I wanted you to see what I was using for the shots. Good thing I copied it to CD and MP3 because it's now in tiny little pieces. OK, let's head down the rabbit hole and see what our grooves really look like.



Here's the dirty record at 50X. As you can see there's much more dust and dirt on it than you could see with your naked eye. And even at 50x, you really can't see much of what's going in the grooves where it really does matter.

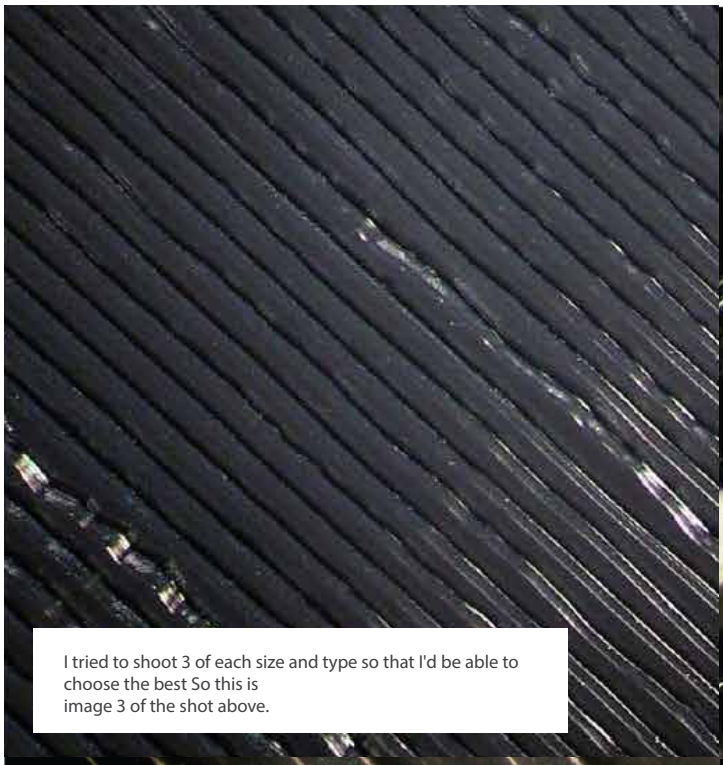


I tried to shoot 3 of each size and type so that I'd be able to choose the best. So this is image 2 of the shot above.

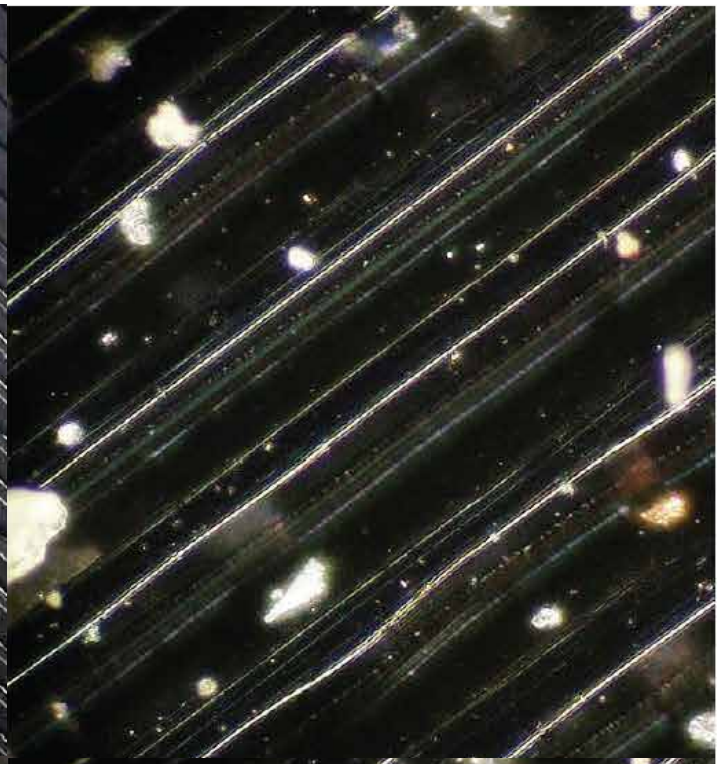


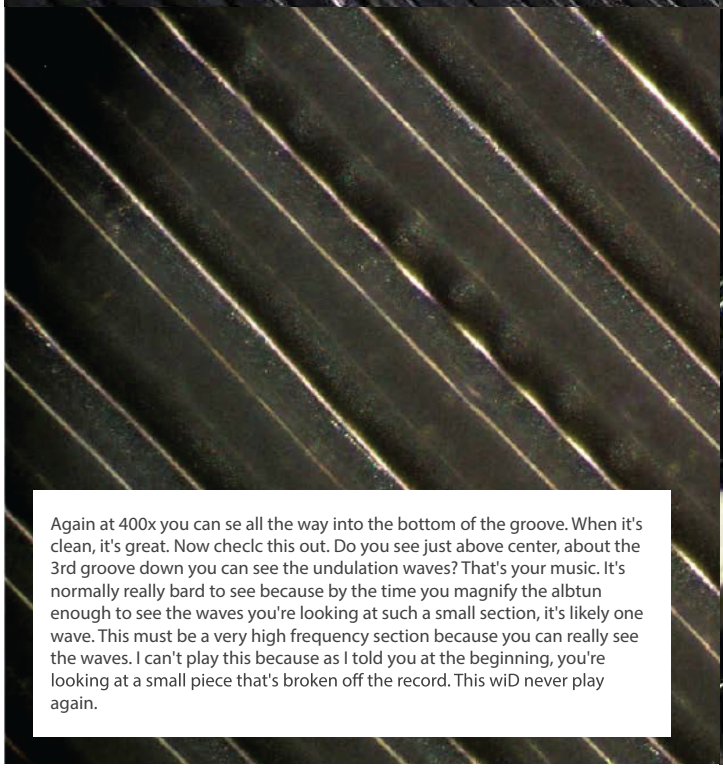
Here's the clean record at 50x. The color looks a little different than the dirty record, but thafs just the way we lit it Anyway, as you can see keep your records covered, sleeved and clean them frequently so you will have d ean records to listen to.

I tried to shoot 3 of each size and type so that I'd be able to choose the best. So this is image 2 of the shot above.

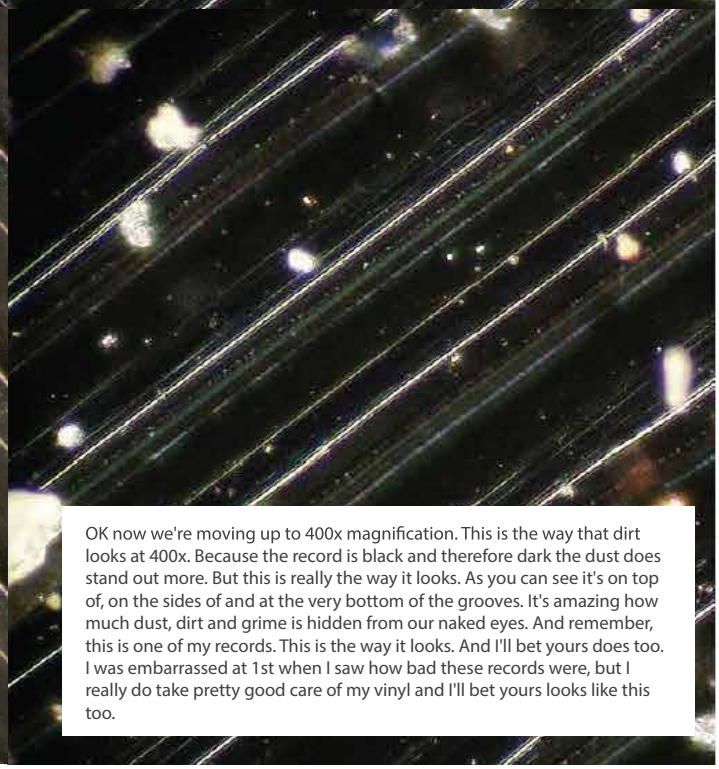


I tried to shoot 3 of each size and type so that I'd be able to choose the best So this is image 3 of the shot above.

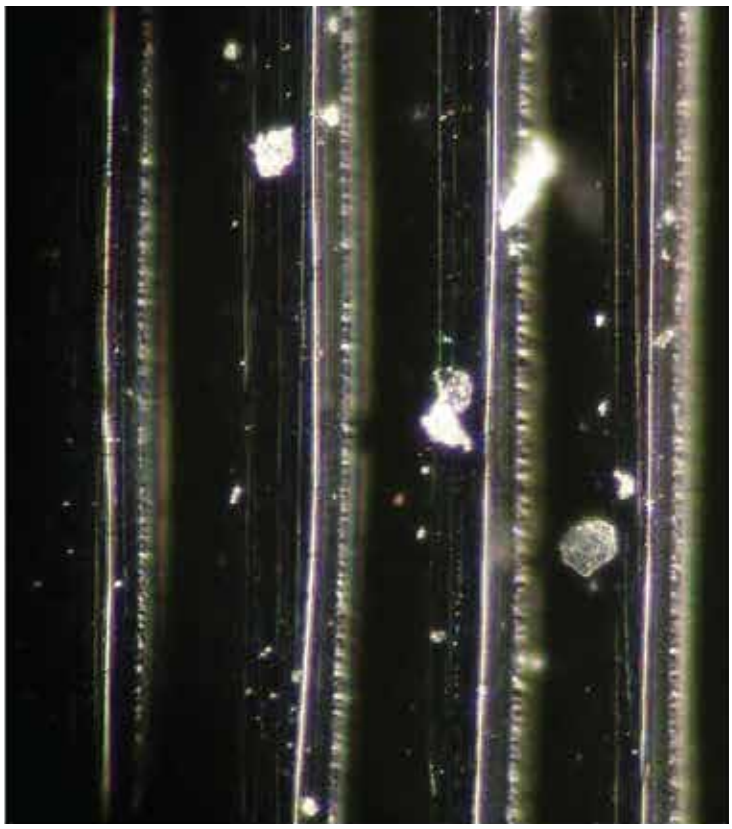


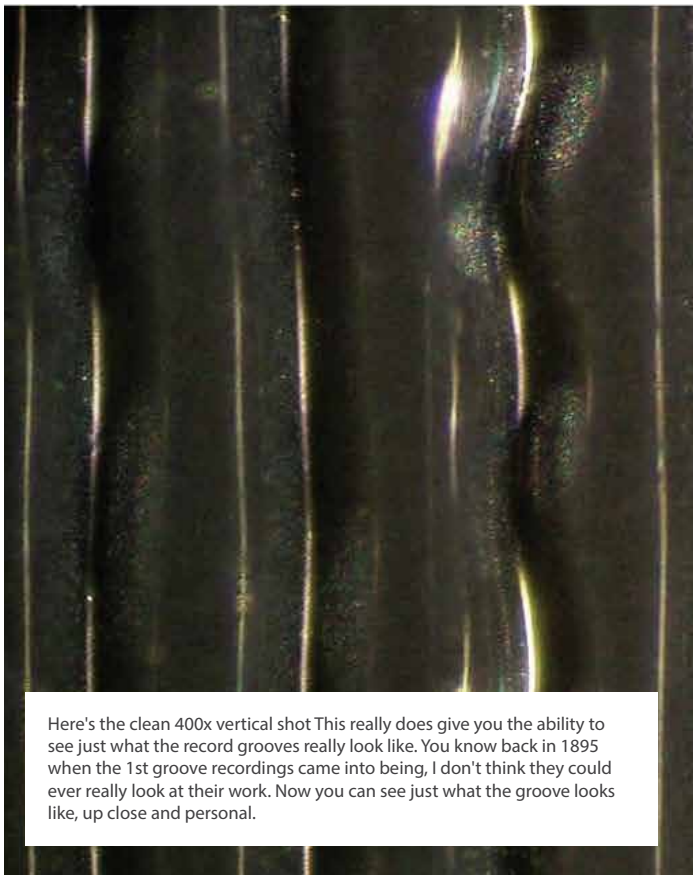


Again at 400x you can se all the way into the bottom of the groove. When it's clean, it's great. Now checlc this out. Do you see just above center, about the 3rd groove down you can see the undulation waves? That's your music. It's normally really bard to see because by the time you magnify the albtun enough to see the waves you're looking at such a small section, it's likely one wave. This must be a very high frequency section because you can really see the waves. I can't play this because as I told you at the beginning, you're looking at a small piece that's broken off the record. This wiD never play again.

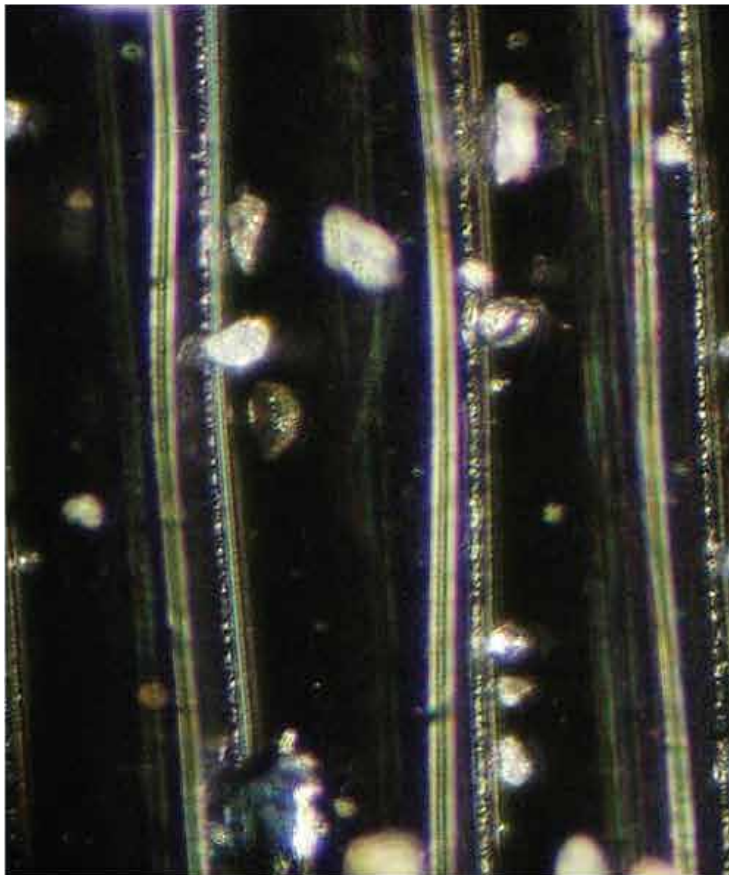


OK now we're moving up to 400x magnification. This is the way that dirt looks at 400x. Because the record is black and therefore dark the dust does stand out more. But this is really the way it looks. As you can see it's on top of, on the sides of and at the very bottom of the grooves. It's amazing how much dust, dirt and grime is hidden from our naked eyes. And remember, this is one of my records. This is the way it looks. And I'll bet yours does too. I was embarrassed at 1st when I saw how bad these records were, but I really do take pretty good care of my vinyl and I'll bet yours looks like this too.

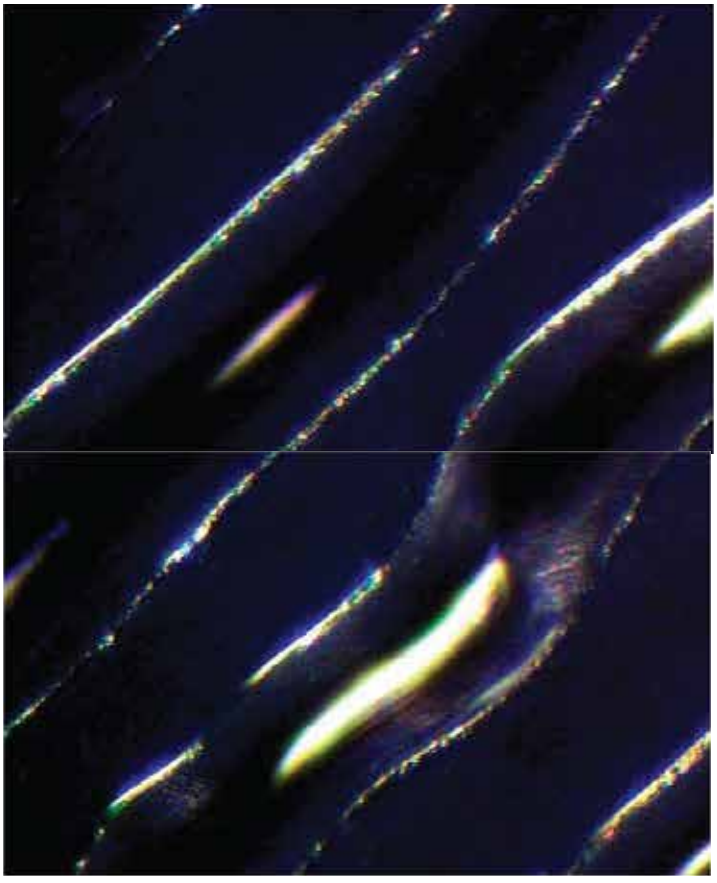




Here's the clean 400x vertical shot This really does give you the ability to see just what the record grooves really look like. You know back in 1895 when the 1st groove recordings came into being, I don't think they could ever really look at their work. Now you can see just what the groove looks like, up close and personal.



OK, the more you magnify, the more light you need. At 800x, looking at basically a single groove you can see just how un-straight your grooves really are. This is as bright as we could get it But it's pretty clear how dirty this groove is and just how the needle will track through it to create your sound.

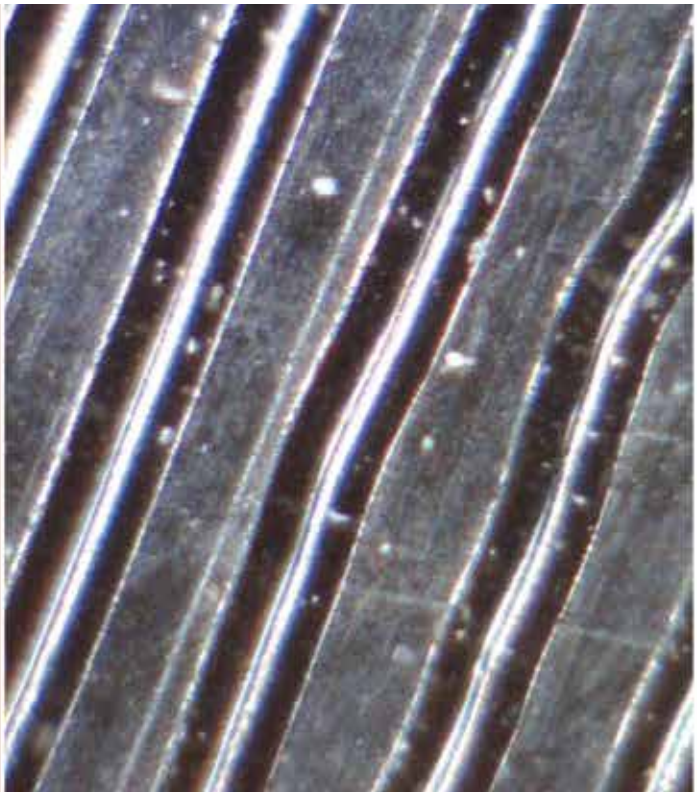


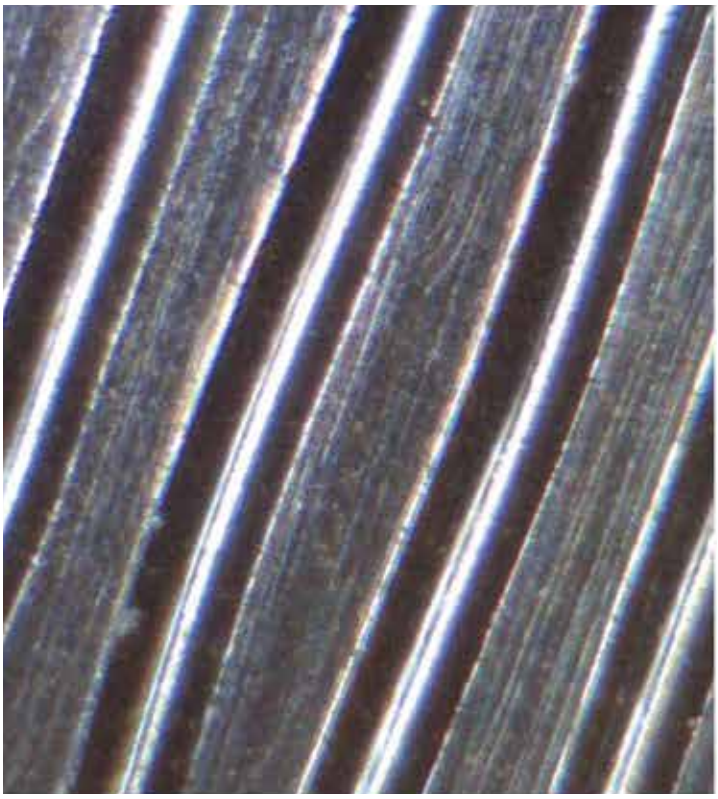
You Can Prove It To Yourself- Easy

Ok you're probably not going to go out and buy a $250 000 scanning electron microscope. But you can buy a USB Micro-scope for about $60 that will give you up to 150x magnification to see your grooves and much, much more. Actually I've had so much fun with one of the little USB Microscopes I brought I wanted you to know. And you'll use it for much more than records. Think of all the things you can look at and save to your computer. In fad. I like this so much, I'm thinking of adding a USB Microscope to OAK's line of product Stay tuned.

Anyway what you see above is me taking a 150x picture of a 78 record that I didn't use in the main review. I'm showing you this mainly because I wanted you to see that you can do tests like this yourself. And because nowhere else in my review did I do anything with 78s. And of course my new OAK Carbon Fiber anti static brush works equally well on 78s and 45s, just like it does on LPs.

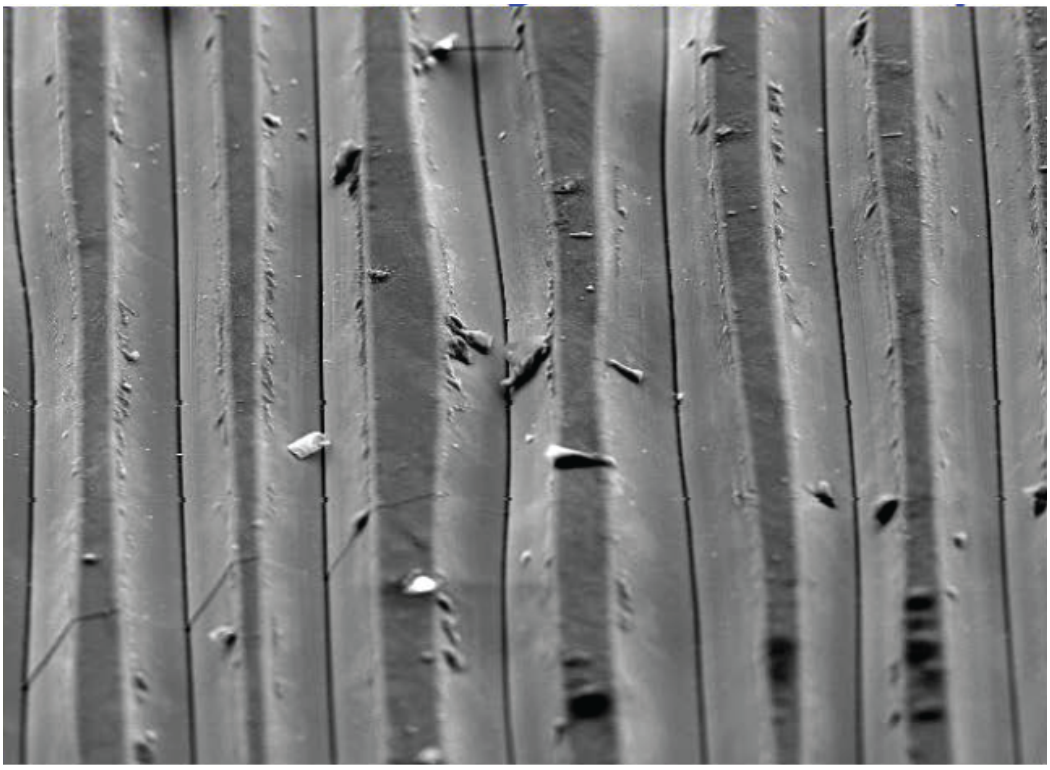
OK, let's look at my results below.



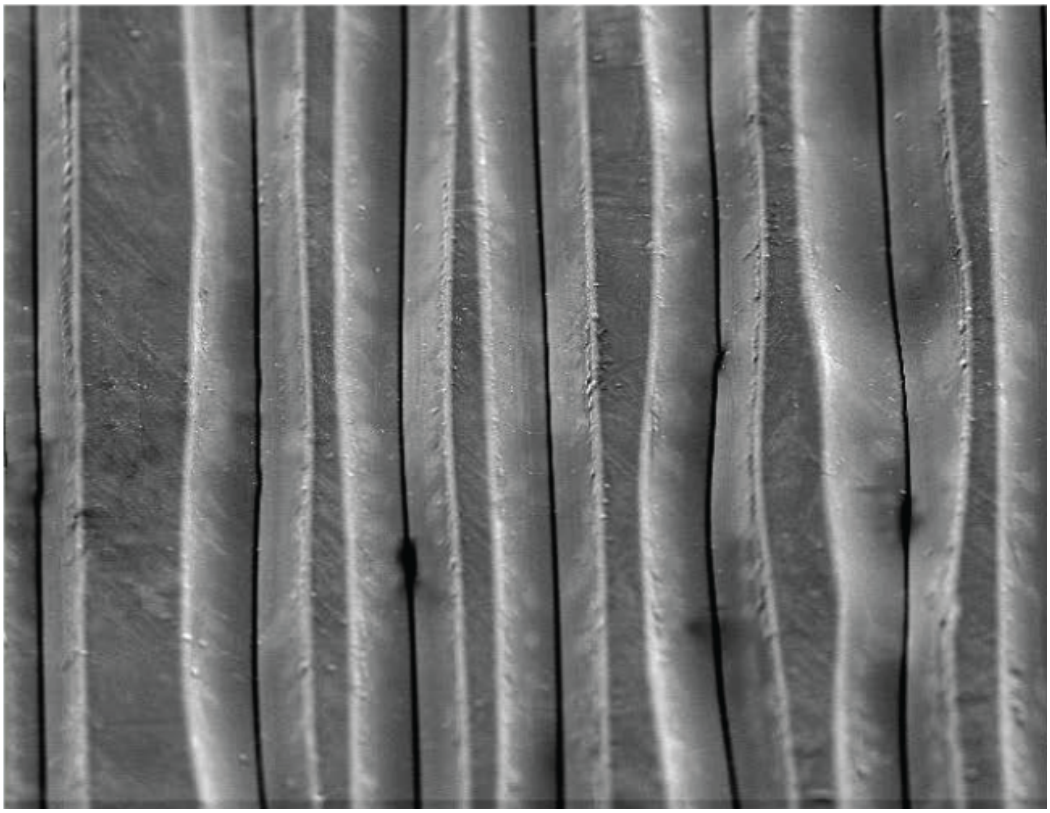


Here is 150x picture of the grooves of my 78 ofTennessee Ernie Ford's singing "You Don't Have To Be A Baby To Cry". You're looking at the surface at about 150x. As you can see I've kept it in pretty dean shape for a record from the 30s or 40s. It's over 70 years old. It's even older than I am. Anyway, lefs see what it looks like after I clean it

Let’s Use The Scanning Electron Microscope



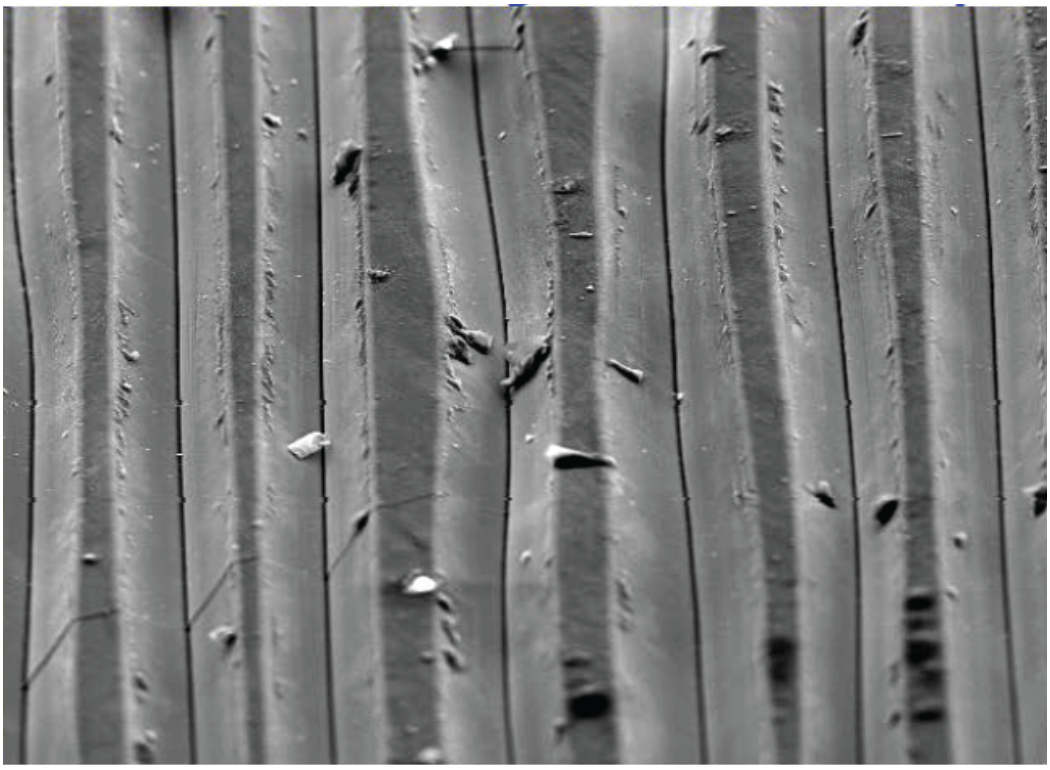
Because records are so dark, they absorb light. So we switched to Scanning Electron Microscope. I was going to buy one to do this but when I found out they cost about $250,000, I decided we'd use the Lab's. Anyway here you can see a dirty record. The electron microscope uses electrons rather than a light, so that's why all electron microscope pictures look silver or gray. So, it's same records, just different technique.



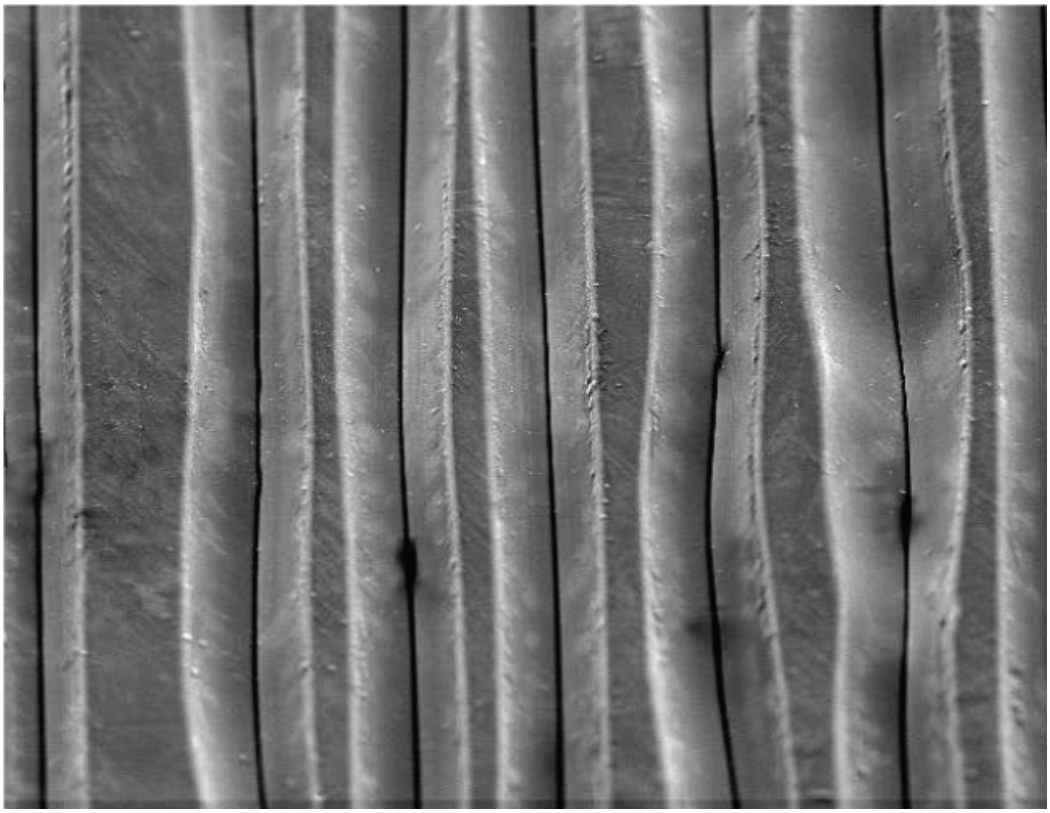
Here's the clean LP under the electron microscope. It gives you a different perspective than the meteorological optical microscopes. It just costs much more.

Because records are so dark, they absorb light. So we switched to Scanning Electron Microscope. I was going to buy one to do this but when I found out they cost about $250,000, I decided we'd use the Lab's. Anyway here you can see a dirty record. The electron microscope uses electrons rather than a light, so that's why all electron microscope pictures look silver or gray. So, it's same records, just different technique.

Let's Use The Scanning Electron Microscope



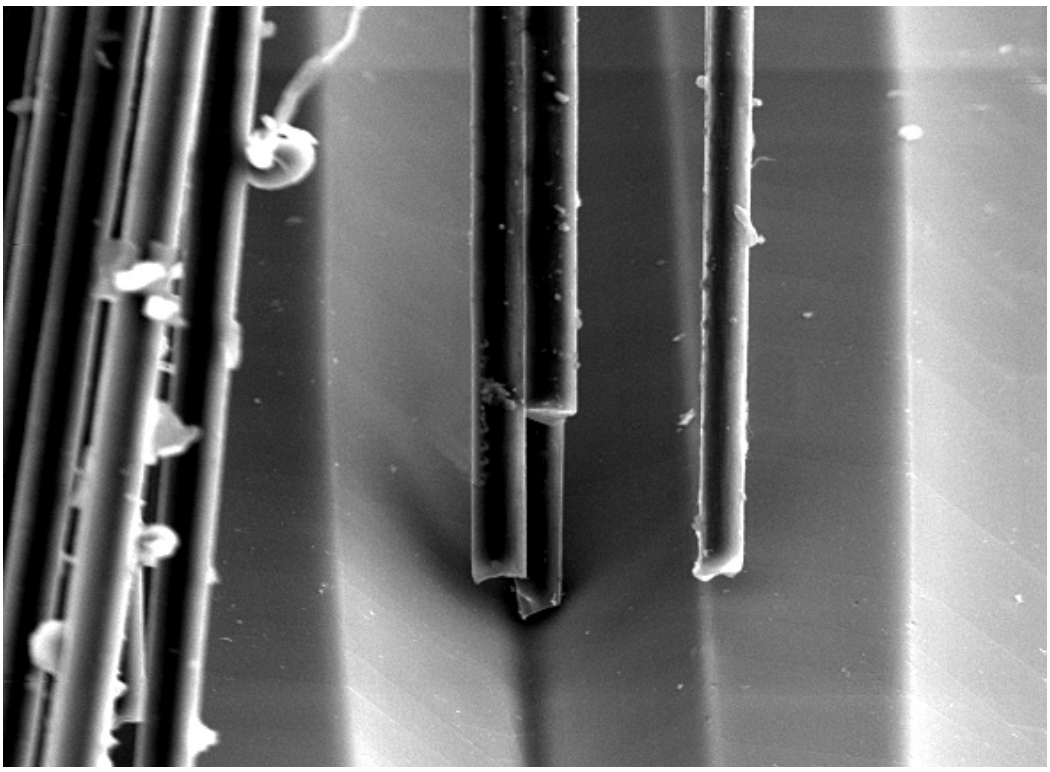
Because records are so dark, they absorb light. So we switched to Scanning Electron Microscope. I was going to buy one to do this but when I found out they cost about $250,000, I decided we'd use the Lab's. Anyway here you can see a dirty record. The electron microscope uses electrons rather than a light, so that's why all electron microscope pictures look silver or gray. So, it's same records, just different technique.



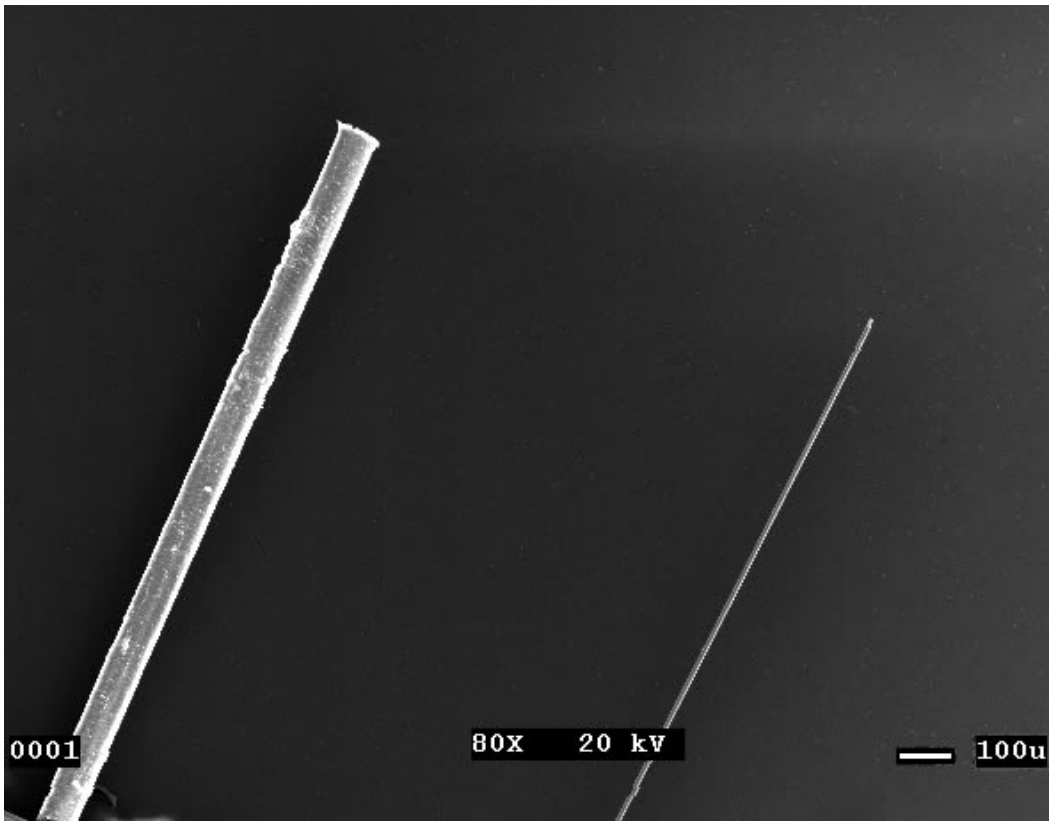
Here's the clean LP under the electron microscope. It gives you a different perspective than the meteorological optical microscopes. It just costs much more.

Oh, just so you know. a meteorological opti cal microscope (and there is more, but this is the main difference) looks down on the subject and the light is shown from above or at an angle from above. A biological microscope, the kind we are used to from school, looks through the subject {slide) and the light shines up from the bottom. So for looking at the record, everything is from the top. That's why we use a meteorological microscope. Now you know.

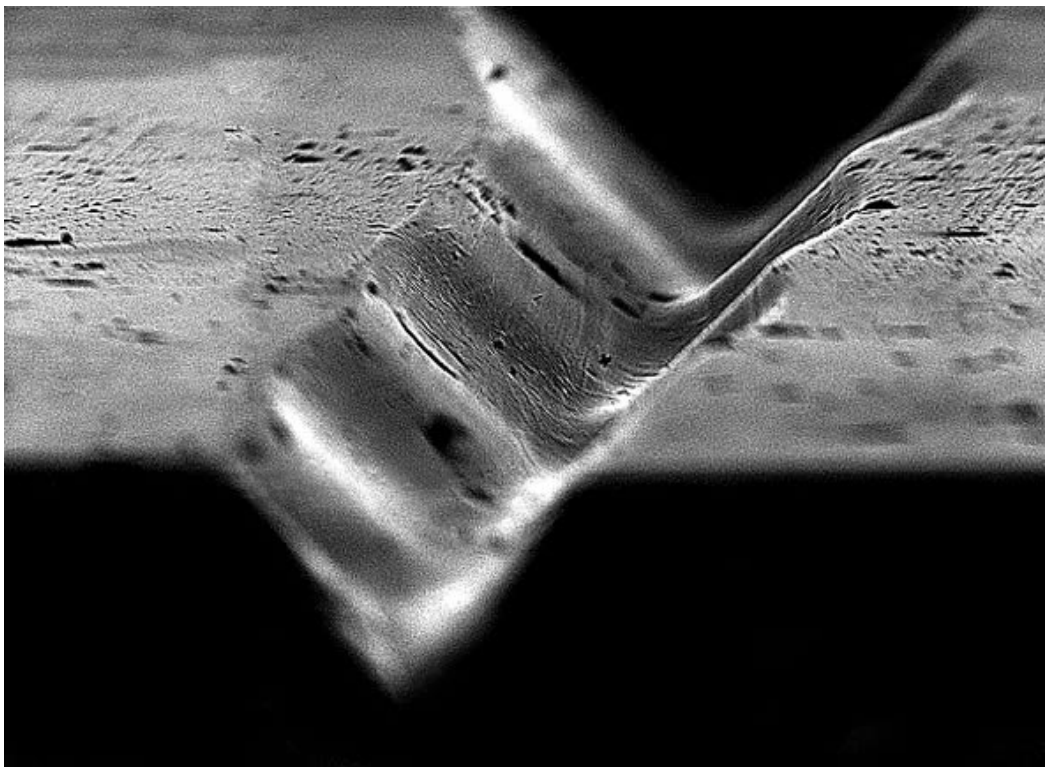
Let's Use The Scanning Electron Microscope



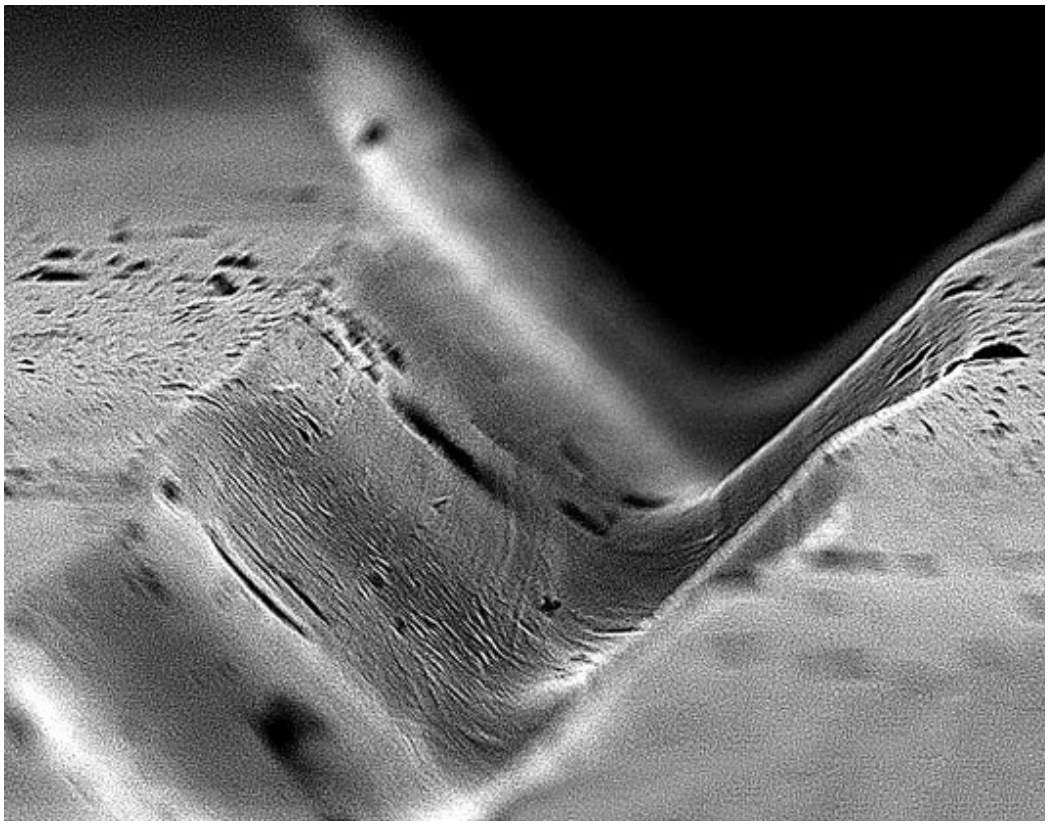
Here under the electron microscope again, you can see just how the small carbon fibers can reach all the way to the bottom of the groove. Here you see 3 in the groove. But remember there are over 1 ,000,000. And as you can see to the left, they really do attract the dust right off the record. Then you just clean the brush against the handy mount and do another record. But the main thing is that they are small enough to get into the groove and there are a million of them to remove the dust, dirt and micro-dust Plus of course since they drain the static electricity, the dust isn't immediately attracted right back.



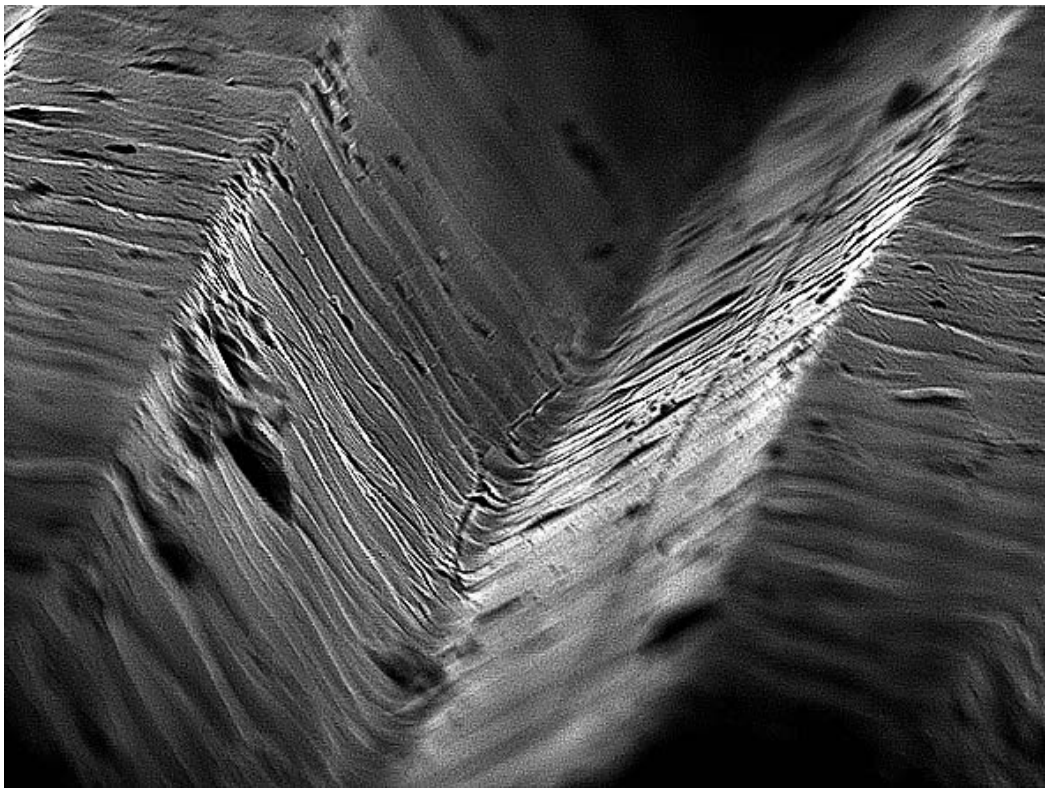
OK so now we are back to cleaning your grooves. Above you can see one of the reasons why carbon fiber is so much b etter than traditional brush-es. It's so much smaller. On the left is a human hair. On the right is the carbon fiber. Of course size is just one reason to use carbon fiber. But you can clearly see how much smaller carbon fiber really is.



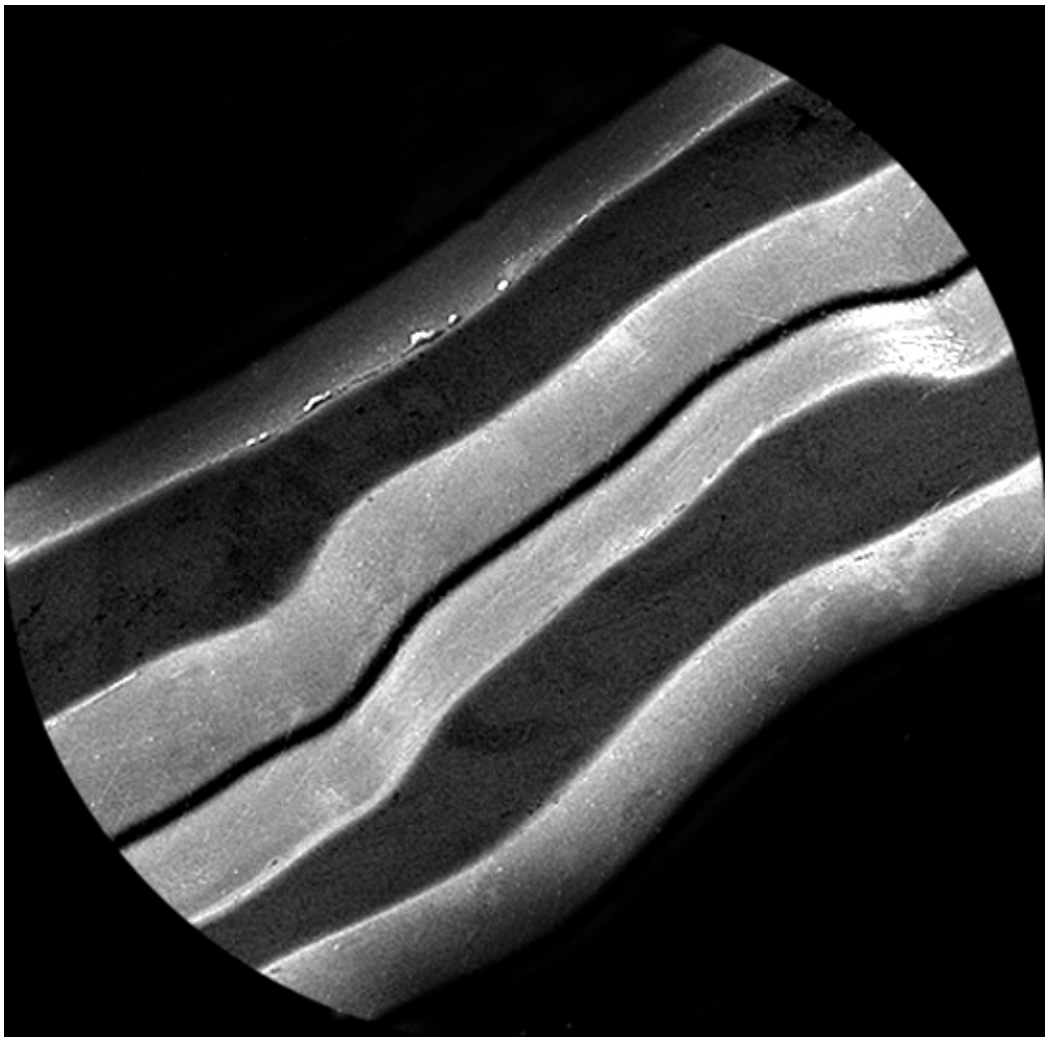
I wanted to show you the groove just like the stylus sees it from the side at 1 OOOx. More records were killed and injured to get these shots, but this really is a stylus eye's view as like a surfer, it shoots through the groove.



OK this was really tough. You are looking at a 1500x shot of the groove from the side. What you see is a wave starting just to the left and if you look carefully to the right you'll see 2. Your stylus has been seeing this for more than 50 years. Now you can see what you've been hearing.



Here's another shot of the groove at 1500x. This time we're shooting from the top. What you are seeing here is higher frequency waves. Do you see them on the groove walls? This is why I like to shoot multiple pictures. I get lots more chances to show you the best parts. And this one is an awesome groove picture.



Now you can see just one groove. This is where the sound is cut into the vinyl and where the stylus picks up the waves. Remember it gets the sound from the sides of the groove and you can see up close thanks to the electron microscope just what your stylus sees. And now you've completed your trip down the microscopic rabbit hole to see just how your records store and reproduce all that great music. I sure hope you've enjoyed learning about this as much as I've enjoyed creating it for you. And, now you know just what your new carbon fiber brush can do to help your sound be the best ever by thoroughly cleaning deep, deep, deep into your grooves. Added copyright

Enjoy DAK's Carbon Fiber Anti Static Vinyl Record Care System...Sol

Explore