



Welcome to our presentation, “Electroplating Explained to a New Generation of Platers and Pressers.” In terms of the actual plating, I know some of you have or will be taking the tour of Welcome to 1979’s facility, and there’s no substitute for seeing these processes close-up, so my intention here is to give you a somewhat broad-stroked view of how the space-age techniques of electroforming fit into a 100+ years old industrial process of cranking out vinyl records, because it is a vital production step.

If you are considering whether to integrate plating into your own operations, we will also explore the opportunities and challenges awaiting you.

I hope to sidestep most of the “in-the-weeds” technical issues but never fear - our chief engineer and company founder Alex Greenspan is here as are one or two experienced production hands who can get me off the hook by fielding those kind of questions.

It's about
replication +
mass
production



So at its heart we are talking about an industrial process designed to accurately replicate recorded content into hundreds or thousands of end-products – vinyl records!

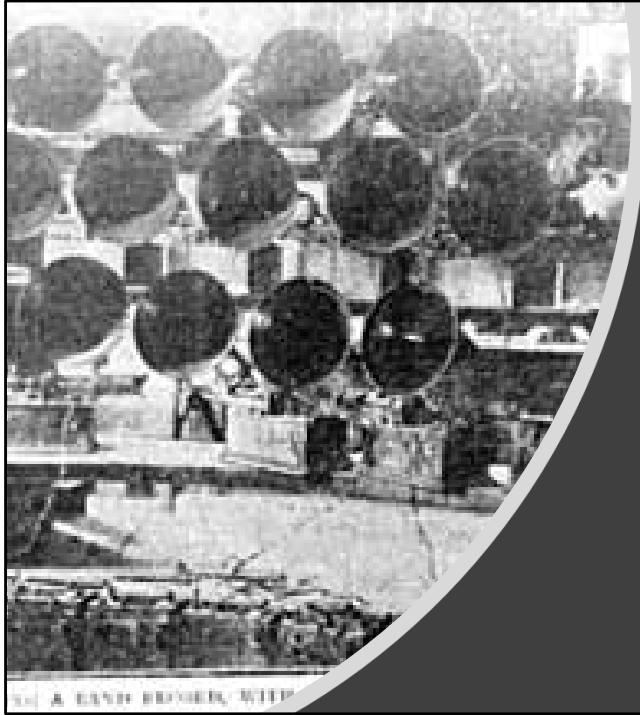
Just for fun, let's give this a little historical context.



Thomas Edison, among his many other inventions, is famous for creating mechanical and then electrical reproduction of sound with his iconic sound horns . The analog sound waves were etched onto a rotating wax cylinder directly from the sound and later a first generation “master” cylinder.



Here's a state-of-the-art recording studio, circa 1900!



Mass Production?

Believe it or not, the earliest method of replication was to simply repeat the live performance over and over again. This fuzzy picture shows an array of recording devices set to transcribe a speech or musical performance. These wax cylinders at best could only hold 2-3 minutes of content, so you could do a lot of repetitions in a few hours...



Not very efficient for mass production! Edison, always looking to make a better mousetrap, then developed a metallic master cylinder that could be formed from a single wax master, which is analogous to the lacquer. This method involved applying a vaporized gold solution into the wax master grooves as a conductive seed layer (hence “Gold Mould”) in a vacuum chamber followed by an electroplating that laid copper onto it. The original wax master, like the lacquers today, was discarded and the new metal master which was an inverse replica (with ridges, not grooves) was used to create additional molds and then end- products.

Blank wax cylinders are inserted into the mold and heated and expanded so that the mold patterns would impress into the wax. These were branded “Edison Gold Moulds” and are collector’s items today but not worth all that much as there are still quite a few of them out there, and you can even find devices to play them.

See https://en.m.wikipedia.org/wiki/Edison_Records for more details.



Early Discs

Emile Berliner

Lateral cut discs were first introduced by Emil Berliner around 1889. He founded the Gramophone Company in 1894 and later several related businesses including Deutsche Grammophon in Germany. The earliest discs were inferior in sound quality to cylinders, but because of continuous enhancements and the ability to “press” these with a metal mold, discs ultimately won this early “format” battle.

An early Berliner disc



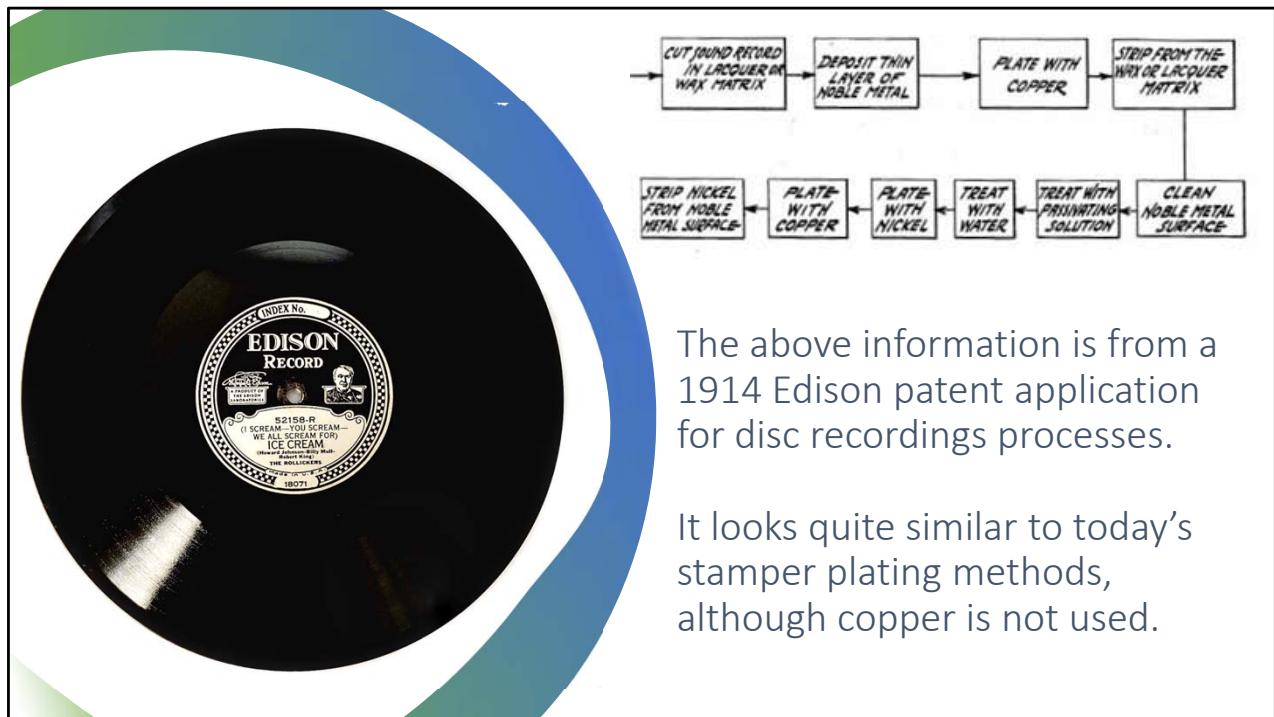
Berliner's acid etching of a zinc master disk made reproduction of multiple copies of a single recording much more practical, but only a few stampers could be made from one master. Also the recording, cleaning, acid etching, removal of wax, and the problem of acid etching surfaces other than the recording grooves, resulted in a difficult process, and a relatively high surface noise of the resulting recording. Eventually the wax gave way to a shellac compound.

The Original Audio Format War



Edison fought valiantly to compete against the discs by increasing their recording time and stressing the higher sound quality. He felt that because the cylinder spun at a constant speed throughout the recording, it was less prone to distortions caused by changing spin rates as the stylus moves towards the center of the disc.

For a really good recounting of this early audio war, see this article at JP'S Blog:
<https://jpcavanaugh.com/2020/08/28/audio-format-wars-cylinder-vs-disc/>



The above information is from a 1914 Edison patent application for disc recordings processes.

It looks quite similar to today's stamper plating methods, although copper is not used.

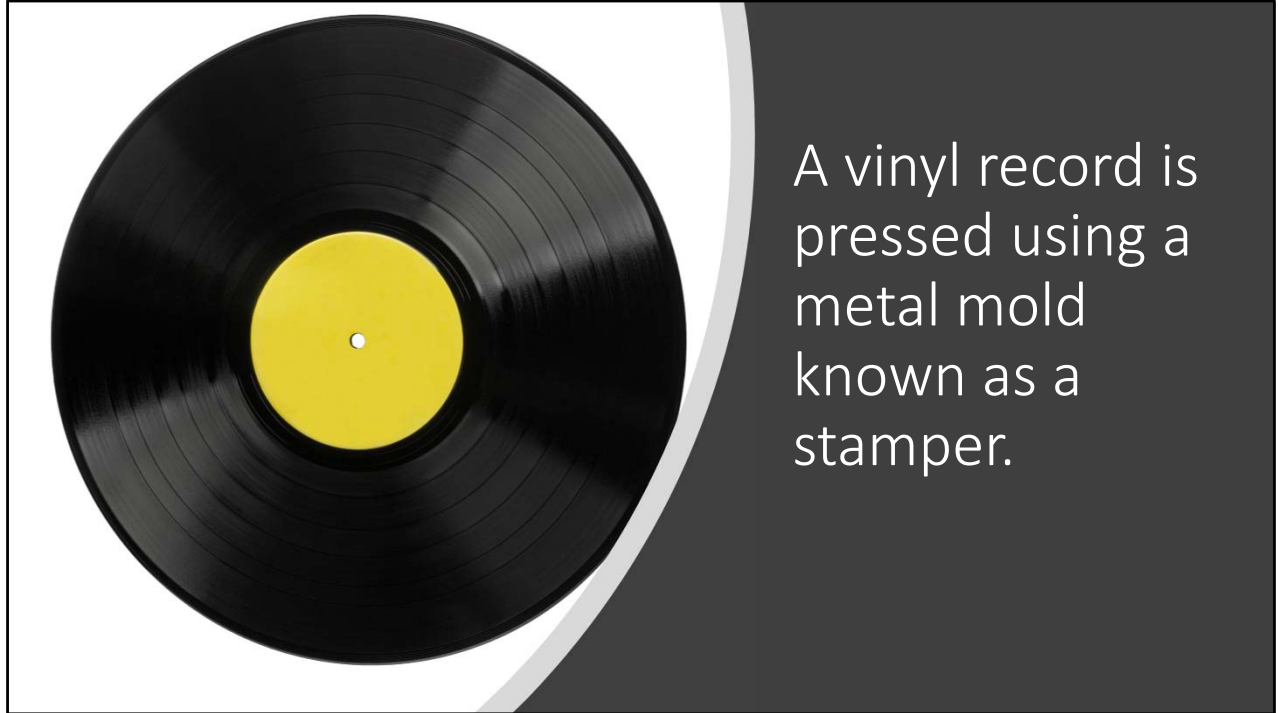
The early Edison discs were made up of **a core of compressed wood flour (later China clay) with a layer of "Condensite" (a phenolic resin varnish) bonded to the surface on which the recording was engraved.** (Made from 1912 – 1929)



By the 1940s, record manufacturing methods were pretty well standardized, and almost identical to today's methods in terms of process and chemistry.

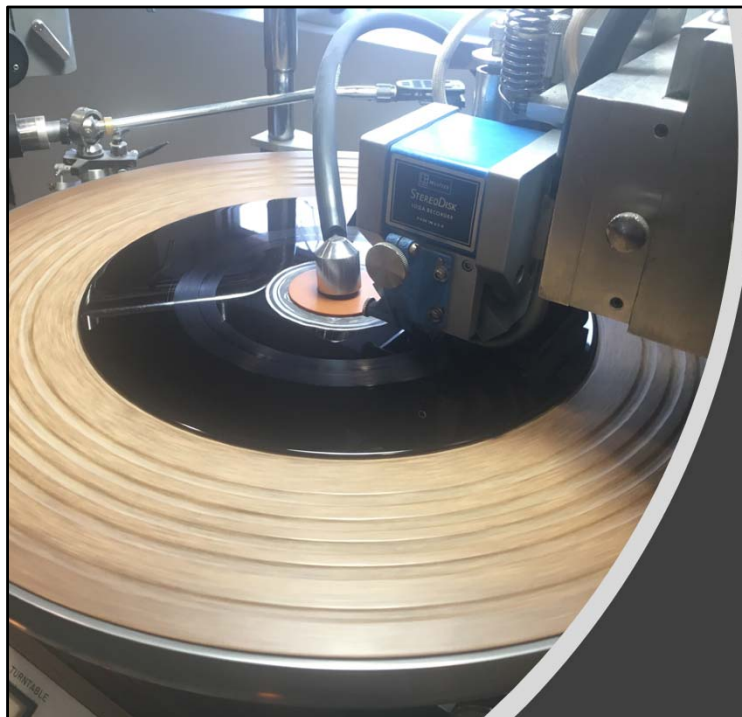
Everything Old is New
Again!





A vinyl record is pressed using a metal mold known as a stamper.

OK, let's fast forward to present-day, and get down to the basics.



The process starts with the lacquer master, etched with the analog sound waves from tape or in some cases, a live performance.

The musical content of the lacquer is equivalent to the vinyl end-product; but to get there it is used to create an inverse replication in metal, the stamper.

Assuring the quality of the stamper is mission critical to the quality of the vinyl end-product.

(photo credit United Press)



—

This stamper is created through a multi-step electroplating process that forms an exact mirror-image of the three-dimensional sound patterns etched into the lacquer grooves.

Steps to Vinyl Production

Lacquer Master

Metal Stamper

Pressing

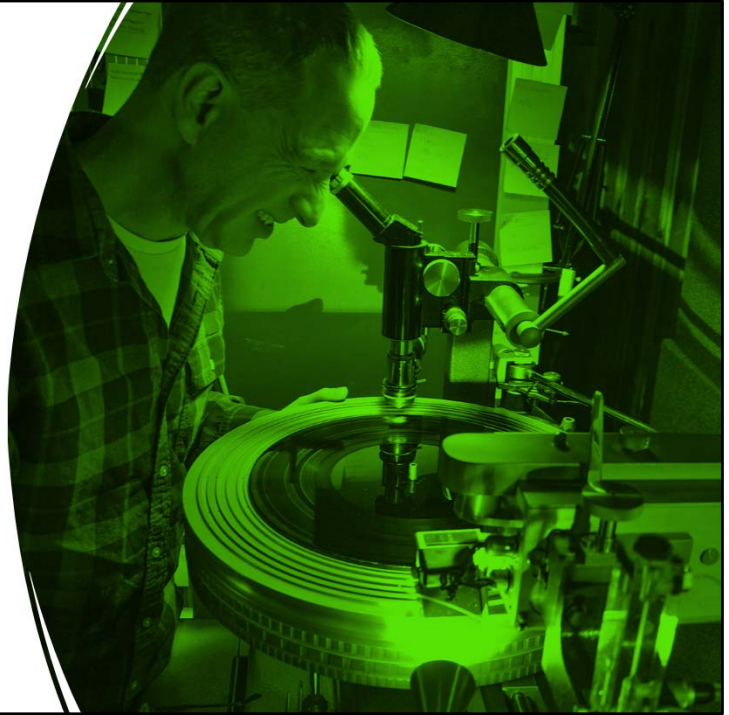
In order to produce a vinyl record, each of these three activities must take place sequentially. Each activity represents a discrete operation requiring its own location, specialized equipment, and dedicated personnel.

In our present global vinyl marketplace, you will find companies that provide all of these activities under one roof, two of these activities, or just one of them. At one time, the big record labels vertically integrated these 3 operations to produce their content, but today the labels and artists are customers of business providing these services.

A few examples...

Alex Abrash (AA)Mastering

Plainview, NY
Mastering only



AA Mastering lays down lacquers – no plating or pressing.

Mastercraft Plating

Desmond Maraine,
(Elizabeth, NJ)
Stamper plating only



Our friend Desmond Maraine has a busy plating shop in the wilds of New Jersey. I know many people at this conference use his services...

Third Man Records

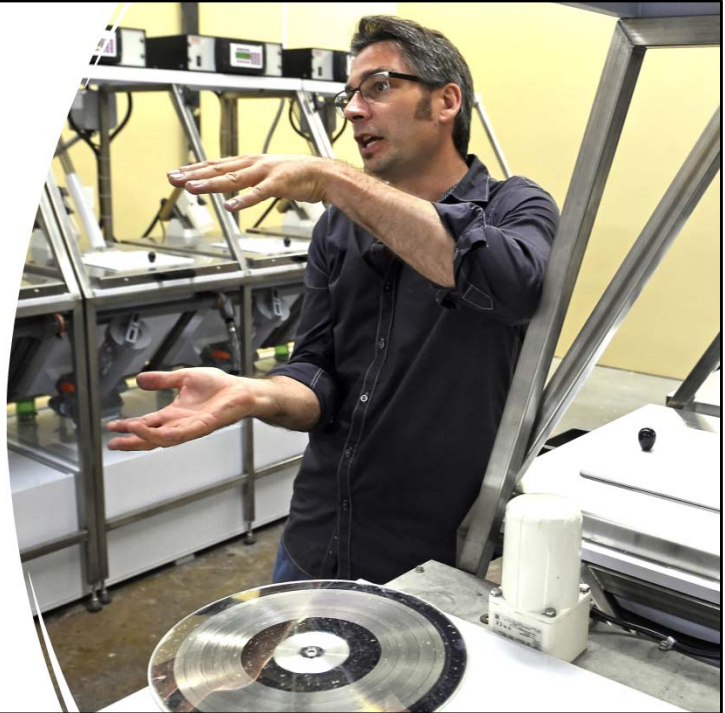
Jack White, Detroit
Studio mastering + pressing



This famous guy now runs a modern pressing plant and two mastering studios, but no plating services.

Welcome to 1979

Chris & Yoli Mara, Nashville
Studio mastering + stamper plating



And here's our friend Chris Mara, who offers high-quality plating and studio mastering, no pressing.

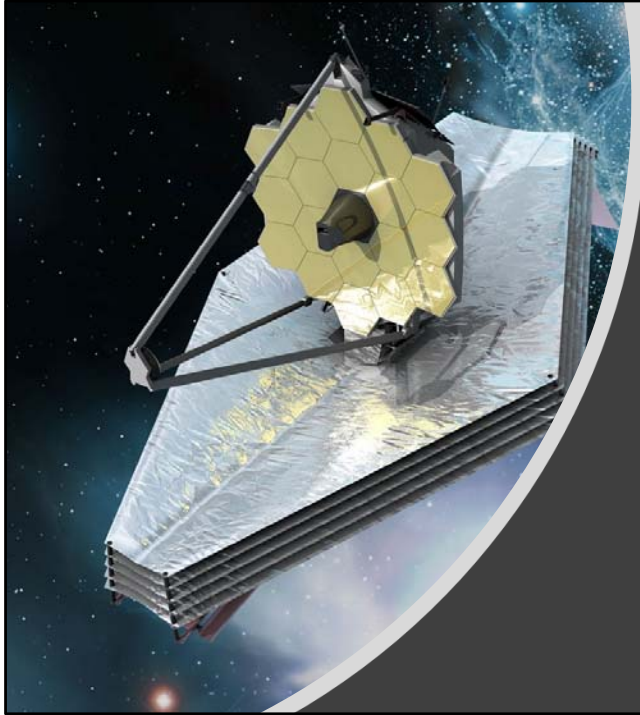
So all of this is by way of illustrating that the vinyl manufacturing process is a chain of multiple, complex and often far-flung process activities serving a niche industry where demand far exceeds capacity at present. Many artists and promoters are shocked by the lengthy turn-around time for having a vinyl recording in their hands, at least until they understand what goes into making that record.

Let drill down now on the plating component...



What is electroplating? (or more precisely, electroforming)

We like the term electro-forming to distinguish it from the general concept of plating, i.e. covering an object with a flat layer of metal, as in jewelry, auto parts etc. Here we are actually “growing” 3-dimensional micro-structures onto the groove patterns to form the stamper.



By the way...

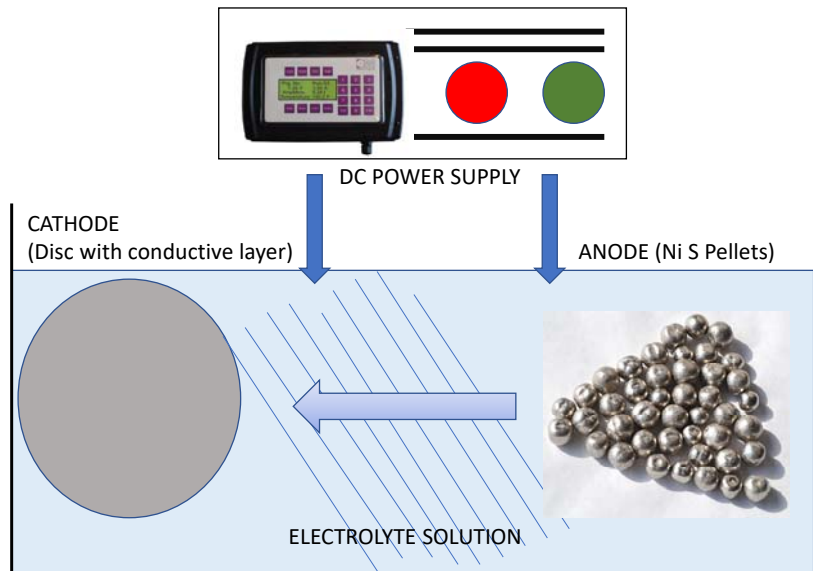
Electroforming is also used in some of today's most cutting-edge nano technologies...

- Microchips
- Holographics
- Medicine
- Optics used in space telescopes, 3-D gaming, defense

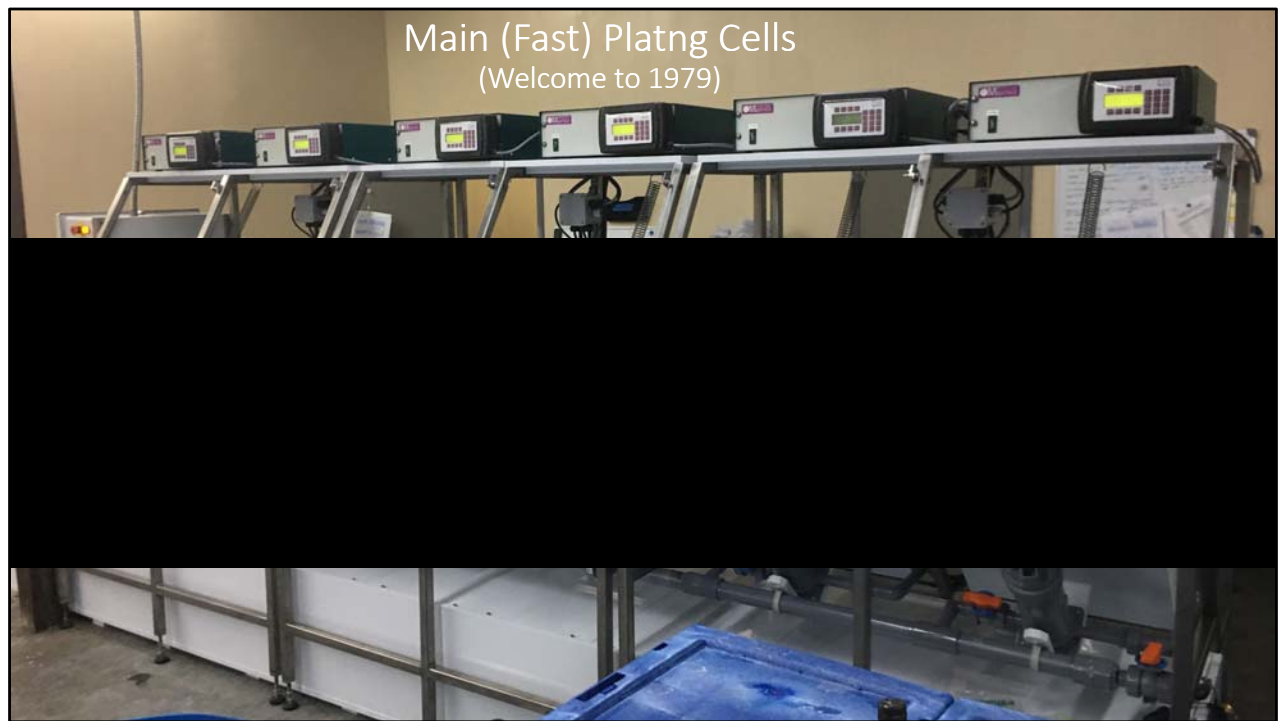
And yes for making those old-time vinyl records...

Something we like to point out...

Manufacturing at the atomic level



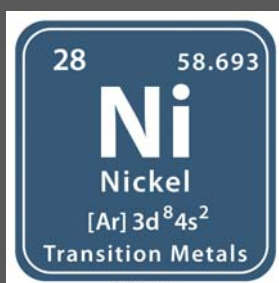
Here's a very simplified illustration of the process of transferring nickel molecules to an etched disc to ultimately become a solid stamper capable of pressing out 1000 record sides...



A more fleshed-out illustrative photo showing our 6-cell fast-plating system.

Molecular transfer of an element to a conductive surface.

- **Nickel (Ni)** is the element of choice for stampers
 - Durable and resists corrosion. Super high melting point
 - Plentiful on earth – most ubiquitous element
 - Relatively inexpensive (currently ~\$13.00/pound)
 - But pricing can be volatile – think Russia, a big source of Ni



Let's give a shout-out to Nickel!

Ni – Discovered in 1751

Atomic Number

Atomic Mass

Electronic Mass

Melting point is 2651° F / 1455° C



Steps to Plating

Silvering - creates a conductive seed layer on top of the lacquer

Pre-Plating - sets down a first layer of nickel at lower temperature

Fast Plating – final nickel deposition to form first stamper or “father”

Family plating – additional stampers from original for production scale & backup

Finishing

OK now let's drill a bit into the sub-activities involved with plating.

Silvering

Silvering the Lacquer

Because nickel cannot plate directly onto the lacquer, the disc must first be coated with a conductive “seed layer” of silver.

The Digital Matrix silvering booth provides an automated spray that provides a precise application of silver nitrate solution to each disc.





SILVERING SYSTEM

While silvering can be done manually, it is a very critical step in preparing the disc for plating, so the automated application is important for both efficiency and quality control.

Silvering is the most chemical-intensive and “messy” part of the plating operation because of the spraying and use of consumable solutions for preparation and cleaning. Thus the operator is wearing full face-covering with air filters, and actual installations will feature a ventilation exhaust hood and barrier. Excess solution and rinse water will be filtered, captured and follow local waste-removal guidelines. (Nothing down the drain!)

The pre-plating tank is designed to hold 4-6 silvered lacquers. Despite the name, it is actually a plating tank whereby a base layer of nickel is applied at a low temperature and amperage for about 20 minutes or so before the discs are placed into their primary fast plating baths.

This step prevents the high heat and current from damaging the still fragile silver/laquer patterns while growing a foundation for the main plating to build on.

Pre-plating is possible using the main tanks, but would prove very inefficient in a production setting.

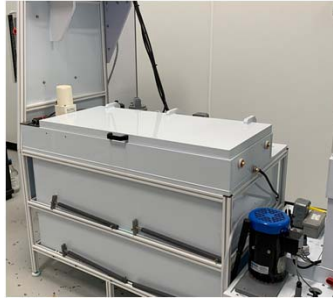


One of the important innovations our equipment brings to modern electroplating is the ability, through a combination of software and mechanics, to standardize each aspect of the plating process. Meaning that the specific recipe combining current, heat, pH, and circulation can be customized, saved, and called on with a push of a button. This allows for high efficiency and low defect rates for each stamper being made.



Silvering Prep Station

+



Pre-plating tank

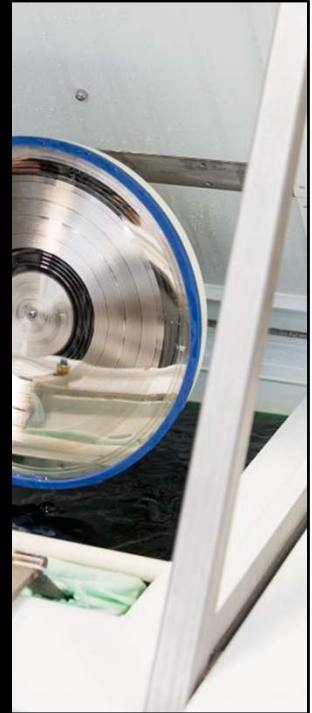
+

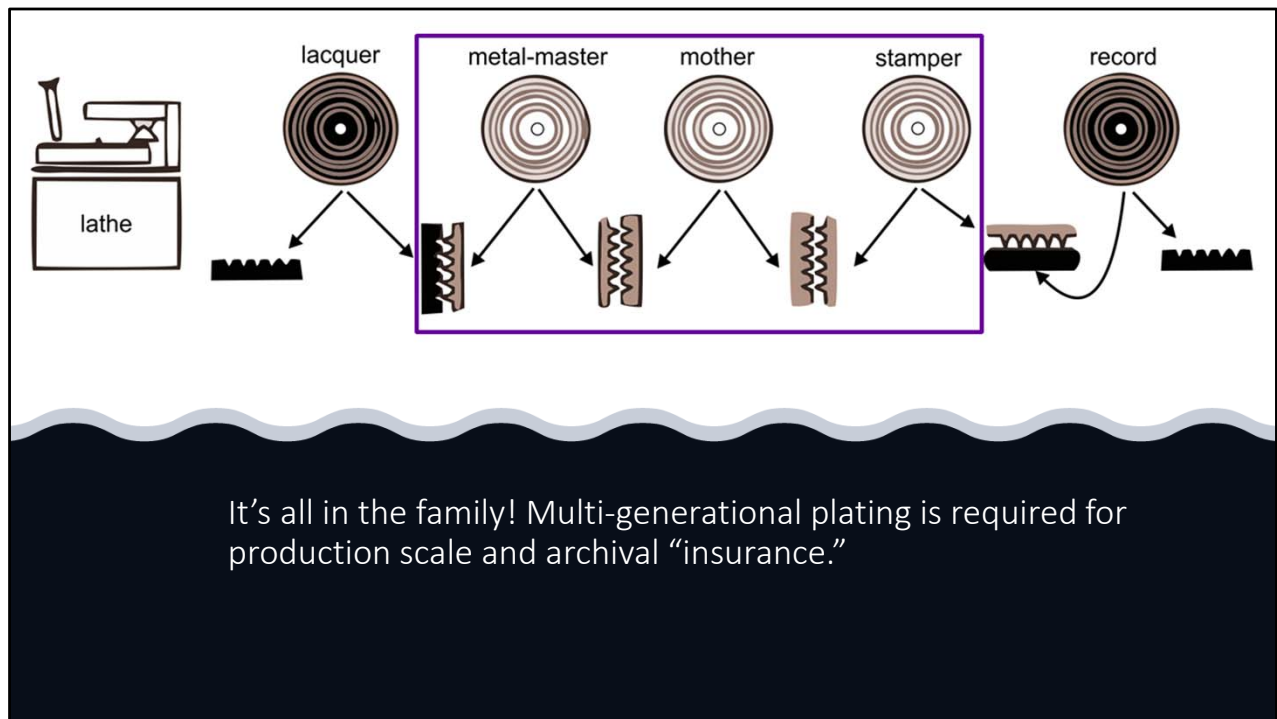


Fast plating cells

Typically folks investing in a plating operation will be looking at these three products from us. We offer some variations in the capacity and features of the pre-plating and fast plating systems. On new installations we will usually send a technician on-site to help with operational start-up and training.

Out of the
plating bath...





We had another activity our plating cycle – family planning! This can be a little confusing, especially when using gender terminology, but it is basically the process of creating additional stampers and backup masters from the first disc plated from the original lacquer. In the trade that disc is called the “father” because it can give birth to a second master, called a “mother” which can in turn be used to generate additional stampers (children).

It is a fact that the first “father” can itself be used as a stamper in a 1-step plating process. We have at least one customer that is working with a one-and-done approach. However, most plating operations will want to go to at least 2-steps initially – having a mother that replicates the now-destroyed lacquer so that additional stampers can be created for high production or as “insurance” in case of damage or loss of the father.

The mother, since it is a grooved replication of the original master, can also be played on a turntable to inspect the content quality. (Fun Fact – to play a metal mother the turntable must be played counter-clockwise, that is rotated backwards, as its grooves are a mirror image of the original recording.)

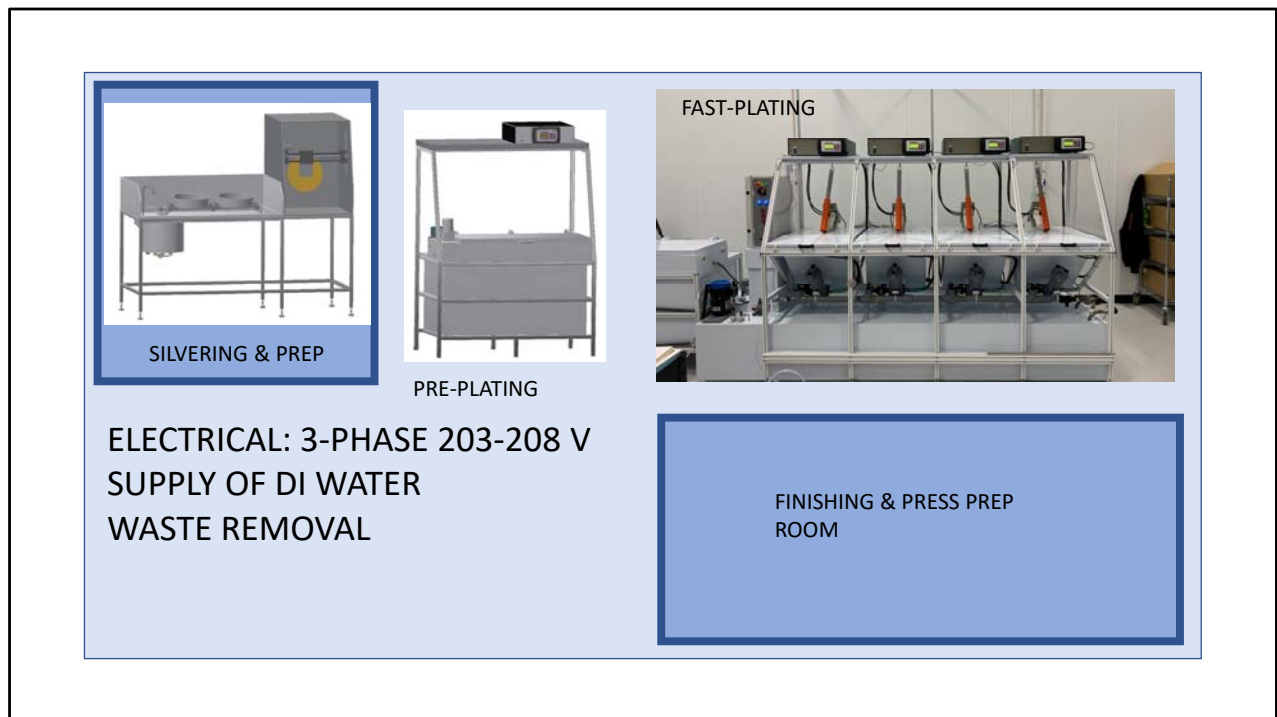
But for large scale production, you will generally want to produce multiple stampers. A general guideline is that one father can create 3 mothers which in turn can create 5 stampers each. And each stamper can be used to press 500-1000 vinyl records before wear

and tear makes it unusable.



The final step of the plating operation is the final finishing and forming of the plated disc into a press-able stamper – trimming, back sanding, center punching to conform to the requirements of the pressing equipment. There is a whole set of specialty tools for this final phase before pressing, primarily available through two companies – Sibert (<https://www.sibert.co.uk/>) in the UK and RPA (<https://recordproducts.com/>) in Connecticut, USA.

I'm pretty sure representatives from both companies are here at the conference.




This slide is a representation of the elements brought together in a building specifically for plating operations. The overall space would vary based on the size and amount of equipment, but generally we have seen these assets contained in spaces starting at about 2000 square feet.

Note that you will want to separate the silvering and finishing areas with solid barriers or their own rooms.




How much is
the
investment?

- The outlay for plating equipment, not including finishing tools, will start in the neighborhood of \$180K and can easily exceed \$250K based on the specific systems and capacity purchased
 - Chemicals not included – app. \$10K for start-up
- 




ROI Calculations?

- How much does it cost to produce 2 stampers?
 - We don't know! (exactly), but we estimate, based on a recent calculus we worked up for some investors, that the plating material cost will end up between \$60-90 per album side stamper. That is based on a full 3-step plating operation ending up two stampers to press about 1000 albums
 - Currently a single stamper goes for around \$200 selling price (varies widely)
- 



Operational Considerations

- After start-up, process chemical costs are low – low consumption rate
 - Nickel is **the** major consumable – every ounce purchased is consumed 1:1 with the amount used in each plated disc
 - Labor required is minimal – two competent technicians can generally handle all of the plating and finishing activities
 - Good ventilation and DI water supply required
- 

A note on hiring personnel – many of the most experienced and competent folks in this field are past their working years! But we have seen that it is not too hard to bring along new generation of technicians where being good is just a matter of learning the skills on the job.



Environmental concerns?

- Yes, but not all that onerous
- The main plating cells are basically closed systems that require replenished water levels but very little chemical adding
- The main focus for handling waste will be in the silvering area
- See list of chemicals used in accompanying notes
- The word “plating” will raise red flags in many jurisdictions, but in most cases can be addressed satisfactorily with reasonable waste removal measures for chemicals used.

SILVERING CHEMICALS USED

Silver Nitrate (reagent)
Sodium Hydroxide
D-glucose
Stannous chloride
Ammonium hydroxide
Formaldehyde
Hydrochloric acid
Hydrogen peroxide (technical and consumer grade)
Ammonia

Deionized water is a must, also a cylinder of compressed zero grade (99.9999%) Nitrogen will be needed to atomize the solutions.

PLATING & PRE-PLATING CHEMICALS

Nickel Sulfamate ($\text{Ni}(\text{SO}_3\text{NH}_2)_2$)
Boric Acid (technical grade 50lb - see Palm)
Sulfamic Acid - Palm
Wetting Agent (eg. "EliminatePitt" is one brand)
Nickel anode in the form of Ni "S" pellets, see "Inco" as one company

Invest in plating?

PRO

- Maximize operational efficiency if you plan to press vinyl at scale
- Eliminate a major bottleneck for your production schedule
- Control quality in-house
- Potential for additional revenue streams as a plating provider – high barrier to entry keeps competition low and demand exceeds supply

Invest in plating?

CON

- Major capital investment – weigh ROI potential with great due diligence
- Operational challenges – this is an every-day industrial activity
- Uncertainties of investment in a niche market dependent on consumer demand and supply-chain economics
- Finding a reliable plating vendor who can meet your production requirements may be a better option



Q&A

Making Vinyl - Nashville June 2022

CONTACT INFO:

Ron Greenspan
Director, Business Development
ron.greenspan@digmatrix.com

www.PlatingPower.com

Digital Matrix Corporation
34-B Sarah Drive
Farmingdale, NY 11735 USA
tel: +1 **516.481.7990 ext. 103**
cel: +1 **757.576.3248** (also WhatsApp, WeChat)
Skype: **rongreenspan**