

Anodes for the **Electronics Industries**

Copper foil electrodeposition
Printed circuit board manufacturing
Lithium-ion battery production



DE NORA
Dare. Develop. Deliver.

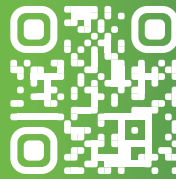
About De Nora

Founded in 1923 and listed on the Euronext Milan stock exchange, Industrie De Nora S.p.A. is an Italian multinational at the forefront of the **global electro-chemical industry**.

De Nora is a **recognized leader** in electrochemical processes and technologies for water management. The company provides electrodes, equipment, services, and integrated solutions that enable industrial processes across the chlor-alkali, electronics, battery, water treatment (municipal and industrial), energy transition, decarbonization and circularity sectors.

With an extensive operational footprint spanning the Americas, Europe, the Middle East, Asia and 5 R&D centers, De Nora leverages its **international**

expertise to deliver worldwide customized, reliable solutions that address evolving market demands. The company remains **deeply committed** to **Environmental, Social, and Governance (ESG) principles**, integrating environmental stewardship, innovation, and social responsibility into its business strategy and daily operations.



Scan the QR code

to discover how De Nora's expertise enables industrial transformation worldwide.

Advanced Solutions for Electronics Manufacturing

The De Nora Electrode Technologies Group is a **strategic technology partner for the electronics industry**, providing advanced insoluble anode solutions designed to **ensure high precision, long operating life, and optimized total cost of ownership** in electronics manufacturing. Thanks to our established partnerships with key players in the electronics supply chain, we offer solutions that integrate seamlessly into our customers' manufacturing processes, ensuring operational continuity, application support, and the ability to meet the technological challenges of the future.

With anodes installed in hundreds of production lines worldwide, our global presence reflects not only **the market's trust**, but also our **ability to adapt quickly** to technological and operational requirements, **ensuring reliable and validated solutions** for our customers. We offer a rich portfolio of technologies and solutions that enable industrial processes across sectors such as:



Chlor-Alkali

High performance cathodes and anodes for chlor-alkali industry.



Electronics

Experienced team can design the right systems for your needs.



Mining & metals recovery

Electrodes designed to enhance efficiency and consistency of deposition, in addition to water treatment applications.



Surface finishing & cathodic protection

Effective, efficient and innovative anode solutions tailored to your process or project needs.

Anodes for Electronics Industries

Committed to providing advanced anode solutions in line with electronic industry requirements.

The electronics market is influenced by continuous technological development and consumers' demand that are reflected in the key components.

The trends towards better connectivity, greater device functionality, performance, and miniaturization, are leading to higher complexity in our customers' products, which require advanced technological solutions more than ever before. Furthermore, the energy revolution, and an **increased demand for lithium-ion batteries (LiB)**, have highly impacted the need of strategic material like copper foil.

DSA[®] anodes for Electronics

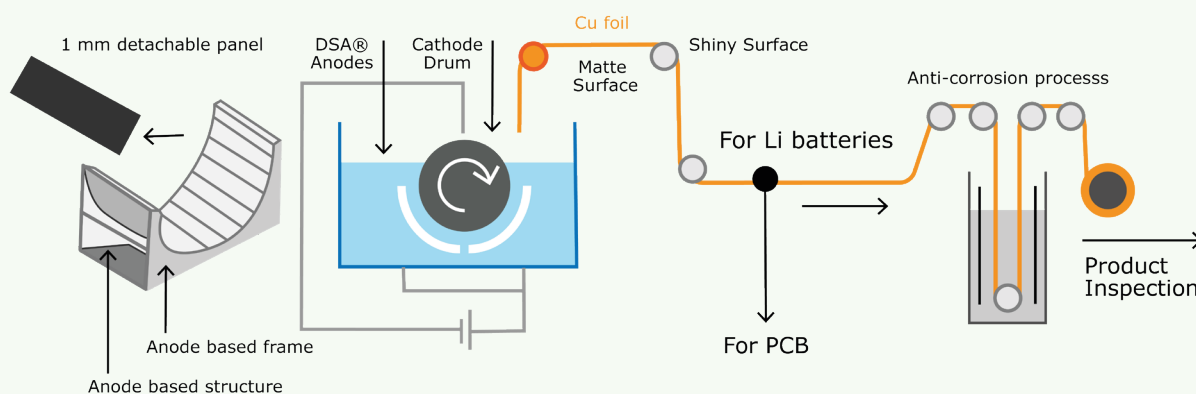
De Nora was the first company to introduce DSA[®] insoluble anodes in the electronics industry for the production of electrodeposited (ED) copper foil and the electrochemical copper plating of printed circuit boards (PCBs).

Over the years, we have continued to invest in research and development by being active participants/partners in the technological progress of the electronics industry. By developing long and trusted relationships with customers, we have been able to improve the electrodeposition process and anode/anode structure cell design, allowing for the introduction of new, superior, high-quality products with high functionality.

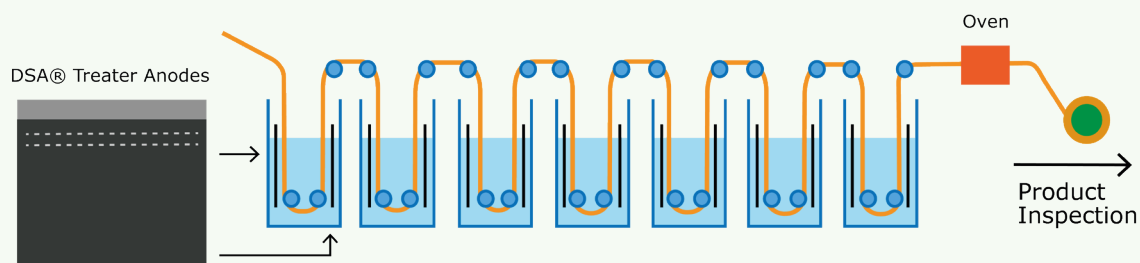
Customers, partners and industries we serve:

- Main producers of electrolytic/electrodeposited copper foils;
- Specialized engineering companies, electrodeposited cell for Copper foil, plating equipment and chemical vendors for PCB Cu plating.

Copper foil Electro-deposition (ED) cells



Surface Treatment machine



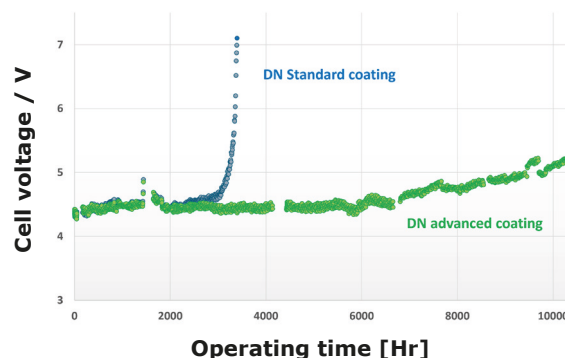
Key features and characteristics of DSA® electrodes:

- **Great Stability:** Insoluble anodes do not deform or degrade during use, ensuring consistent voltage performance and efficient operation over time.
- **High Efficiency:** Electrodes, due to tailored catalytic coatings, facilitate desired reactions with minimal energy consumption and/or ohmic losses, leading to cost savings and improved purity of the products because of an optimal process.
- **Customizable:** Electrodes can be customized to suit different applications and cell configurations - they can be tailored to specific electrolytes, operating conditions, and process parameters.
- **Reusable:** At the end of the catalytic activity, the electrodes may be reactivated- recovering the initial performances without replacing the mechanical structure, hence minimizing the electrodes' total cost of ownership (TCO).

Our products ensure high quality manufacturing of:

- Copper foil for printed circuit boards (PCBs)
 - Rigid PCB
 - IC substrate
 - High Density Interconnection (HDI) board
 - Flexible PCB
- Copper foil for lithium ion batteries (LiB)
 - Negative current collector

Anode life test

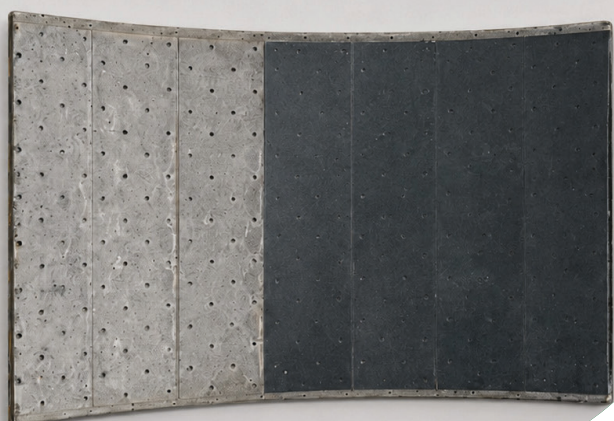


Copper Foil Electrodeposition (ED) anodes

With nearly a century of experience, De Nora can support the copper foil manufacturing industry with electrodeposition anode and anode structure design and electrolytic process optimization, allowing them to operate at a very reduced electrodes gap, and to produce ultra-thin copper foil. DSA® anodes are the right choice for **decreased cost of operation** and **increased efficiency** for high-quality copper foil manufacturing.

We offer:

- Patented anode technologies (**detachable panels, based structures, and supporting frames**) for electrodeposition cell designs
- DSA® anodes for **electrochemical surface treatment** of metal foil, to provide the final product attributes
- Highest level of **field service and technical assistance** available due to global presence
- Maintenance agreement for anodes refurbishment, recoating, repair, refreshing service **for lead removal/washing (Pb washing)**
- Customized offers, including **leasing contracts** and periodic **monitoring of anodes performance**.



Why choose DSA anodes for copper foil manufacturing?

Our insoluble anodes allow operation under varied operating conditions to produce a full range of quality foils and thickness (including ultra-thin foil), covering many applications:

- PCB manufacturing, largely diffused in all the electric and electronics equipment we generally use in our daily life
- As negative current collector for lithium batteries that find application in smartphones, notebooks, personal computers and electric vehicles

De Nora is the partner of choice for the copper foil industry

In addition to all of the above, we offer collaboration and partnership with all of our customers to ensure the ideal solution is achieved.

Technical assistance is available at De Nora's laboratories, and global R&D facilities to allow for collaboration with metal foil companies to optimize operating conditions or qualify new additives influencing anode performances.

Additionally, we collaborate to develop innovative electrolytic coatings that are able to achieve the most challenging requirements in terms of surface morphology and internal structure.

Printed Circuit Board Copper Plating

As an increasing number of products incorporate computing technology, from personal and Internet-of-Things devices, to cars and 5G infrastructure, the demand for printed circuit boards (PCB) is likewise expanding. PCB manufacturing requires specially designed anodes for the electrolysis process, and the quality of these anodes is critical to producing PCBs that achieve high performance standards and product quality, while also minimizing maintenance, manufacturing costs and downtime. For excellent PCB electroplating with strong connectivity, the following insoluble anode attributes are ideal:

Good plating uniformity

Strong productivity

Less additive consumption

Low required maintenance

While soluble anodes can be less expensive in the short term, they have a current density (5A/dm²) that is much lower than insoluble anodes (up to 30A/dm²) and a current distribution that is uneven, as compared to the **highly uniform current distribution of insoluble anodes**. The electrode gap with soluble anodes is typically above 400mm (as compared to 100mm for insoluble), and they have a lower via filling ratio than insoluble anodes.

Also, soluble anodes gradually dissolve during electrolysis, which has several unfortunate results:

- The creation of debris (sludge) in the plating solution, which increases maintenance and decreases product quality
- An anode size and shape that is constantly changing, which impacts performance consistency
- A short operational life, which contributes to frequent and arduous maintenance

Because insoluble anodes do not dissolve, they overcome all these challenges. Their one downside is that they typically have higher additive consumption than soluble anodes, which can increase operating expenses for manufacturers. **De Nora has overcome this challenge with De Nora DT anodes.**

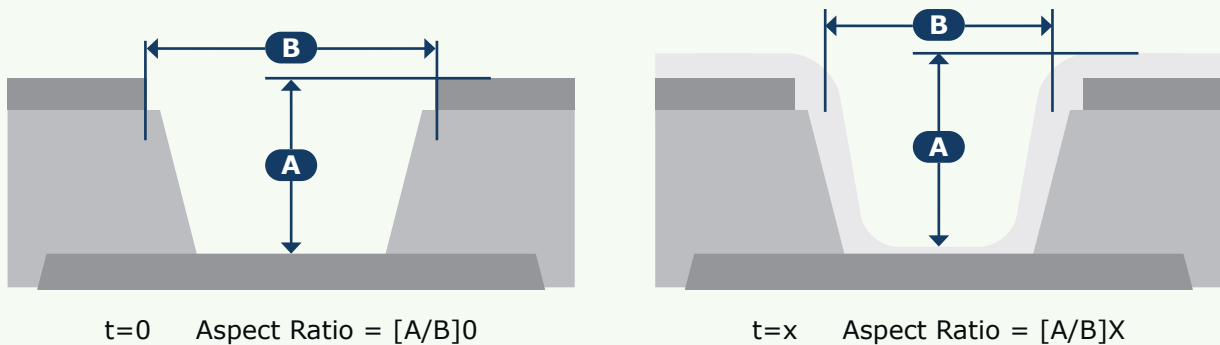
The De Nora solution

With De Nora DT anodes, manufacturers get the best of both worlds:

Long-lasting anodes that deliver high and consistent performance, do not degrade or introduce impurities, require little maintenance, and offer additive consumption equivalent to soluble anodes. Our insoluble anodes are used by leading PCB manufacturers and selected by equipment suppliers for their vertical continuous plating (VCP) lines and horizontal electroplating equipment.

While some insoluble anodes depend on an anode box to minimize additive consumption, De Nora DT anodes have a membrane function incorporated into the coating layer, eliminating the need for an anode box while also minimizing additive consumption. This feature also eliminates the cost of an anode box.

Throwing Power as a Function of the Deposition Time



Uniform current distribution plays a role in via filling. Control of the current density profile, possible with DSA® anodes, can help meet via filling requirements in production.

De Nora DT plating anodes have become the primary choice in **copper-via-filling and mSAP electrodeposition** processes for manufacturing both HDI printed circuit boards and semiconductor substrates. Our insoluble anodes are largely applied by leading printed circuit board (PCB) manufacturers and are selected by equipment suppliers for:

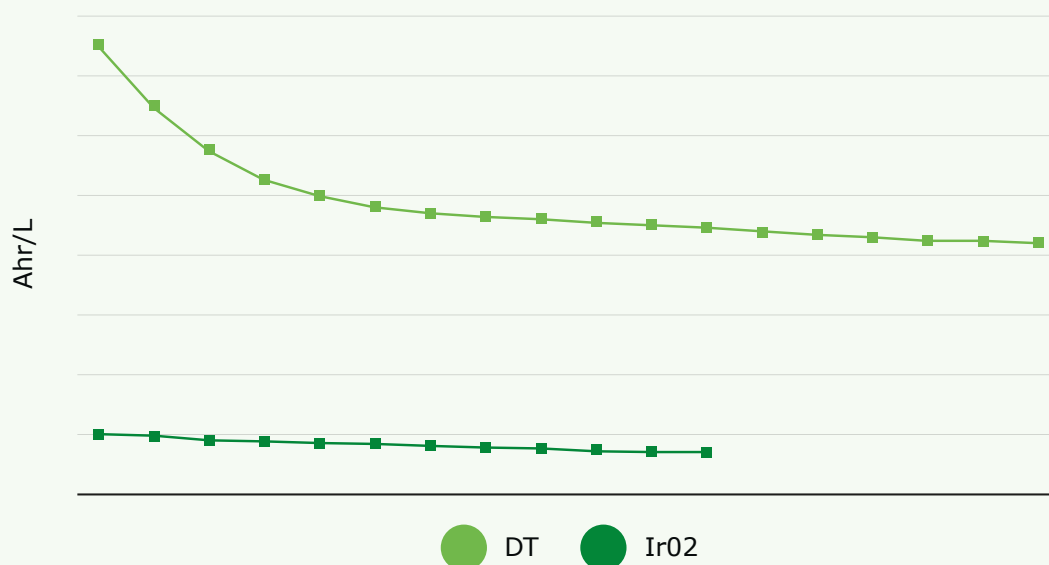
- vertical continuous plating (VCP) lines and
- horizontal electroplating equipment.

De Nora DT anodes:

- Provide high-quality, long-life performance
- Offered in both standard and custom fabricated designs
- Improve straight line throwing power
- Plate copper metal plates deep into high aspect ratio holes and blind vias

Performance comparison of iridium oxide electrodes and DT coating in EVF plating bath

Additive Consumption Profile in VCP line



Why industry leader chose De Nora DT anodes

Why industry leaders chose De Nora DT anodes De Nora DT anodes are offered in standard and custom designs to ensure optimum performance.

Performance advantages:

- Improved copper plating distribution
- 1:1 surface to through-hole uniformity
- Elimination of nodules & surface sanding
- Elimination of anode sludge
- Improved yield
- Eliminates tedious anode maintenance
- Safer operation with light weight titanium anodes
- Ability to operate at increased current density

Uniform copper deposition, reliable via filling ability, elimination of surface roughness, and minimum additive consumption make De Nora DT anodes the solution for today's challenges in the electronics industry. De Nora DT anodes have been specifically **formulated to maintain the stability of organic plating bath additives**. Operation with De Nora DT anodes provides additive consumption equivalent to soluble anodes.

De Nora coatings, marketed under the De Nora DT brand, have been qualified by all main chemical vendors and are compatible with all plating chemicals, including the latest generation.

Customer Services

Upgrade, refurbishment and retrofit services of existing installations

Tailored upgrade and retrofit solutions that enhance productivity, safety, and efficiency while extending the life of existing installations without full system replacement.

Site surveys and health check audits

Comprehensive on-site assessments and performance audits delivering actionable insights, optimization opportunities, and expert recommendations to optimize equipment reliability, efficiency, and asset longevity.

Electrode repair and recoating services

Advanced repair and recoating solutions that restore electrode performance, extend service life, and ensure reliable operation while reducing downtime and supporting sustainable asset management.

Spare and replacement parts

Reliable OEM spare parts, maintenance kits, and customized supply agreements designed to maximize equipment uptime, preserve performance, and support long-term operational efficiency.

Service and maintenance agreements

Integrated service solutions focused on maintaining operational continuity, optimizing asset performance, and supporting long-term reliability throughout the entire equipment lifecycle.

Global presence

An **international network** covering Europe, Middle East, North America, Latin America, and Asia-Pacific.



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Get in touch

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