



**NanoWeb®**  
**TRANSPARENT CONDUCTIVE**  
**FILM**



**Metamaterial  
Technologies  
Inc.**

Mastering Light

## WHAT IS NanoWeb®?

NanoWeb® is a transparent conductor made of an invisible metal mesh that can be fabricated onto any glass or plastic surface.

NanoWeb® offers a superior alternative to Indium Tin Oxide (ITO), Silver Nanowire (AgNW), graphene and carbon nanotube among other ITO-alternative technologies.

NanoWeb® has a nanostructured thin metal layer that is a two-dimensional mesh of continuous wires. The design of the mesh geometry allows for a highly conductive and transparent layer. Due to this high conductivity, it is able to operate using very little power, while remaining clear and transparent. Its grid of highly conductive lines allows more energy to pass through open area surfaces versus unpatterned conductive materials.

The metal mesh has been created from silver, aluminum, platinum, copper or nickel, but it can be done with almost any type of metal. The transparency depends only on the geometrical design of the mesh and not the type of metal material. Sub-micron lines are designed to ensure there is no visibility

to the human eye, ensuring perfect viewing experience and safety. It can be applied to windows, windshields, goggles, visors, and display screens, to name a few, without any obstruction of view. NanoWeb® metal mesh can be scaled up to very large substrate sizes, providing the same electrical and optical performance.

NanoWeb® has been developed using Rolling Mask Lithography (RML®). The RML process enables NanoWeb® to be produced for large products and devices, and films in roll-to-roll production.



NanoWeb® received the IDTechEx Best Manufacturing Technology Award in 2013



## THE SIX CORE BENEFITS:

### Transparency

NanoWeb® has achieved a higher level of transparency for conductive metal mesh compared to current technologies such as Indium Tin Oxide technologies (ITO). Due to NanoWeb's high flexibility of design, it is able to achieve high levels of transmission and high conductivity with very low haze.

### Flexible and Durable

NanoWeb® transparent conductor fabricated on flexible films allows for flexing, bending and folding without affecting performance. NanoWeb® also has the ability to be shaped and molded to an object. Its attributes allow it to cover the surface while maintaining its properties. NanoWeb® is also light weight and can withstand extreme environments. It can be formed on large rigid and flexible surfaces.

### Low Cost

NanoWeb® can be produced on a large scale, allowing the cost per unit to decrease as volume increases.

### High Conductivity

NanoWeb® maintains high conductivity while maintaining high transparency and invisibility of lines. The level of conductivity can be tailored by the type of metal or by the optimization of geometry (linewidth, pitch and thickness.)

### Large Surface Area Coverage

NanoWeb® can be produced to cover large areas of glass or in large rolls of film. Large pieces of the film retain the same performance as any small surface areas.

### Low Voltage

High conductivity allows NanoWeb® to operate with the low voltage power supplies currently available on transportation vehicles and planes, without the need for transformers. Small batteries or even energy harvesting devices would be sufficient to power NanoWeb® on devices like glasses, visors, cell phones and smart watches.





## ANTI-FOG TECHNOLOGY

Whether you are in the air, on land, or at sea, NanoWeb® can act as a resistive heater to generate heat on windows or other clear surfaces, in all kinds of weather conditions. It can de-fog a cockpit windscreen, a ship's bridge glass, or an automobile windshield, removing condensation quickly - saving you time and money. NanoWeb's technology can act as a resistive heater to generate heat on-demand. It can also be embedded into glass or plastic, and can be tailored depending on your specific requirements.

Many vehicles today have heat element lines that are visible on a glass surface

for defrosting a window, especially on the rear window. What makes NanoWeb® so unique is that it is a completely clear and unobstructive heating solution, that does not interfere with your vision.

This technology can also work on goggles, visors, or any type of clear surface. NanoWeb's heater can be applied to the area that requires quick and targeted heating. It works with low power (due to low sheet resistance), compared to other products currently on the market, while maintaining its transparency.



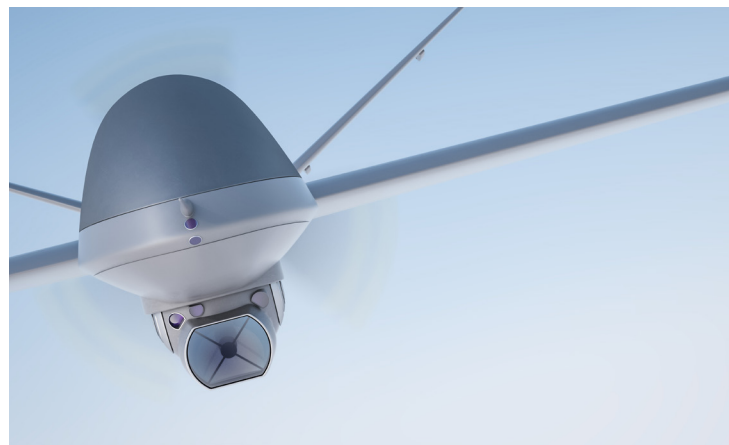


## ANTI-ICE TECHNOLOGY

NanoWeb® can act as a resistive heater to generate heat on windows or surfaces, in all kinds of weather conditions. NanoWeb® can be fitted to a plane's windscreen to remove ice quickly and to ensure that pilots have a clear view. A pilot can activate the process of de-icing whenever required. This could be done whether the plane is in the air or on the ground, with the switch of a button.

NanoWeb® can also be used on goggles, glasses, and automobile windshields, to name a few. This technology can also be used on drones to remove ice while they are in the air.

NanoWeb® provides the flexibility of quickly de-icing a large or small surface area, whenever and wherever needed.





*Above: Glass covered with NanoWeb® is placed over the MTI logo where 12 volts are applied. On the left, the tablet shows the heat signature of the glass measured with an infrared camera. The glass reaches a temperature of 45 degrees Celsius within the first minute.*



*Above: Nanoweb®'s electrical properties do not change after it has completed the thermoforming process.*



## DISPLAYS

NanoWeb® can improve the image quality, response time (sensitivity), and energy efficiency of touch screens. It also enables large area touch screens for digital signage and entertainment. It is light-weight, thin, and flexible.

NanoWeb® is one of the first technologies that ensures touch screen performance is not compromised, no matter the size of the surface area. It has the ability to maintain a high level of clarity and performance and can cover small screens to large window-sized screens. From centimeters to kilometers – conductivity, responsiveness, and transparency will remain the same. NanoWeb's flexibility allows it to be used on bendable displays.

NanoWeb® is the alternative to ITO as it provides high conductivity approaching pure metal values and, at the same time, keeps

the optical transmission high, comparable with uncoated glass or polymer surfaces. The invisible metal mesh is fabricated by a patterning process and can be integrated with trace patterning, which currently is responsible for more than 50% of touch screen production costs.





## TOUCH SCREEN BENEFITS

- NanoWeb® enables submicron patterning, resulting in 300-500 nm regular 2D or 3D metal mesh lines, that are invisible to human eye.
- The sub-micron metal mesh does not form visible moiré fringes with display pixel structures.
- It is the only known cost-effective and production-worthy technology to produce metal mesh electrodes with  $R < 5 \Omega/\text{sq}$ ,  $T > 95\%$  and low haze.
- It allows the formation of metal mesh on large, rigid and flexible substrates.
- Unlike other technologies, haze and transparency are not compromised with sheet resistances  $< 30 \Omega/\text{sq}$ .
- The transparent metal mesh and traces can be produced in the same process step/layer.
- It is the only known technology capable of producing sub-micron metal mesh on glass or film on an industrial scale.

>95%

Visual Light  
Transmission

<5 Ohm/sq

Sheet  
Resistance

<0.5 micron

Trace  
Width



## ADDITIONAL APPLICATIONS



### Anti-counterfeiting

NanoWeb® enables a unique anti-counterfeiting technology that provides the highest level of security through a uniquely designed nanopattern which protects copying and acts as an authenticity signature. This technology allows producers to integrate invisible to the eye ID or pattern to displays, windows, money, credit cards and packaging material.



### EMI Shielding and Transparent Radio-Frequency Antennas

NanoWeb®'s technology allows the fabrication of advanced EMI (electromagnetic interference) shields and transparent antennas for displays, windshields, and other products.



### Solar Cell Efficiency

NanoWeb® transparent metallic electrodes offer record-breaking performance in terms of their high optical transparency (> 96%) and low sheet resistance (< 4 Ohm/square). MTI can manufacture these electrodes on a wide variety of inorganic (e.g. glass and semiconductor) and flexible organic (i.e. plastic) substrates. NanoWeb® pushes the limits on electrode performance, offering a cost-effective alternative for solar to legacy technologies (such as ITO) based on lower conductivity, absorbing, and brittle transparent oxides.





## ABOUT US

Metamaterial Technologies Inc. (MTI) is a smart materials and photonics company that is changing the way we use, interact, and benefit from light. It specializes in metamaterial research, nanofabrication, and computational electromagnetics with access to world-class nanocomposite research. Through applied physics and intelligent design, the company is pioneering a new class of multifunctional

materials—called metamaterials—which have engineered properties that go beyond what is found in nature. MTI has developed a new platform technology that is capable of blocking, absorbing or enhancing light.

MTI is headquartered in Halifax, Nova Scotia and has offices in London, England and Pleasanton, California.

[info@metamaterial.com](mailto:info@metamaterial.com) / [metamaterial.com](http://metamaterial.com)