

Gas and Ion (Plasma) Nitriding: What's the Difference?

By Jake McCann, Process Metallurgist, Advanced Heat Treat Corp.

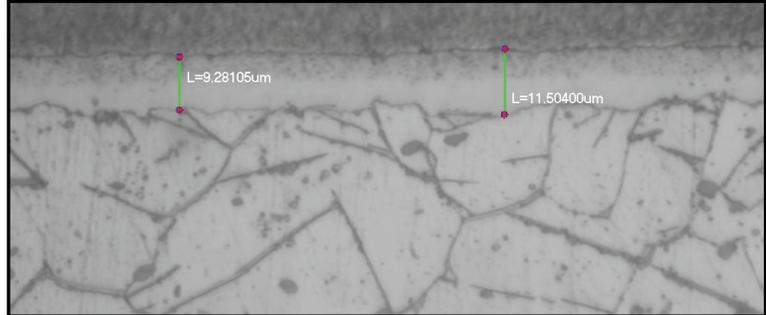
While every surface treatment has its advantages and disadvantages, gas and ion (plasma) nitriding are often compared when engineers decide what is best for their application. Both processes increase surface hardness based on nitrogen diffusion into the product, increasing usable life span, wear resistance and/or fatigue strength, depending on the alloy. Since neither process is a coating on top of the product, there's no need to worry about delaminating of coatings. In addition, in both gas and ion, the compound zone (or white layer) increases corrosion resistance (shown below), and often a post oxidation process can be applied to further enhance corrosion resistance. Both processes achieve very similar metallurgical properties. But there are also very large differences, which could make a direct impact on your parts! Let's take a look at the specific pros and cons of each:

Gas Nitriding Pros

- Very precise temperature control – this leads to consistent and predictable case depth / hardness / dimensional stability
- Full coverage of nitriding - even inside holes and bores
- Great for large quantities of small parts (batch style product)
- Great for alloy steels and low carbon steels

Gas Nitriding Cons

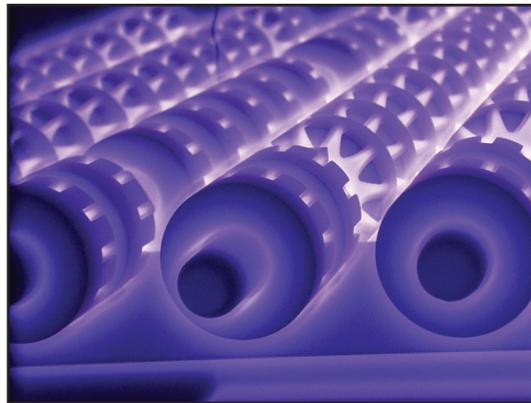
- Without required knowledge, compound zone thickness can exceed desired limits
- Product with too much compound zone could require grinding or machining to remove or reduce this layer
- Parts must be sufficiently “clean” before processing, otherwise “dirty” parts can lead to delayed or inhibited nitriding areas
- Copper plating or masking paint is required to prevent nitriding
- Difficult to process stainless steels due to surface activation requirements
- Increases surface roughness, but to a less degree as compared to ion nitriding



The compound zone acts as a ceramic skin protecting the metal underneath from corrosion. This sample is from low carbon steel and was processed using UltraGlow® Gas Nitriding.

Ion (Plasma) Nitriding Pros

- Mechanical masking (sometimes reusable) can be used to prevent nitriding of specific areas of the product
- Great process for alloy steels and stainless steels that require surface activation to allow for nitriding
- Ion bombardment helps “sputter” clean the surface
- Gases used for processing are safe and environmentally friendly



UltraGlow® Ion (Plasma) Nitriding creates a clean surface.

Ion (Plasma) Nitriding Cons

- Limited on compound zone thickness (maximum) due to the nature of the process
- Relatively less superior temperature control (as compared to gas) – this can lead to variance in case depth / hardness / dimensional stability
- Increases surface roughness

As you can see, there are definite advantages and disadvantages to both processes, which is why it's critical to involve your heat treat specialist during the design phase. The team at Advanced Heat Treat Corp. is always happy to walk you through the best surface treatment for your desired results!

About the Author

Jake McCann has been with Advanced Heat Treat Corp. since 2011. He started at the Burton facility in Waterloo, IA as the Process Metallurgist. In 2015, he transferred to the Michigan facility, also as the Process Metallurgist, where he currently is today. Jake has his Bachelor's degree in Materials Engineering from Iowa State University and helps AHT customers solve their wear and corrosion issues every day!



Jacob McCann



Advanced Heat Treat Corp.