Reactions that occur at the surface of the part during nitriding

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After machining and before nitriding, the surface of the parts often contains non-uniform layers of material and a variety of contaminants, among others:

- Oxides formed upon exposure to air and humidity.
- Organic residues and grease from previous processes.
- Dust and particle deposits.

These act as barriers that prevent proper diffusion of nitrogen ions on the surface of the part and, as a result:

- Poor layer homogeneity.
- Irregularities / weakness of the nitrided layer.
- Impact on expected mechanical properties.

1

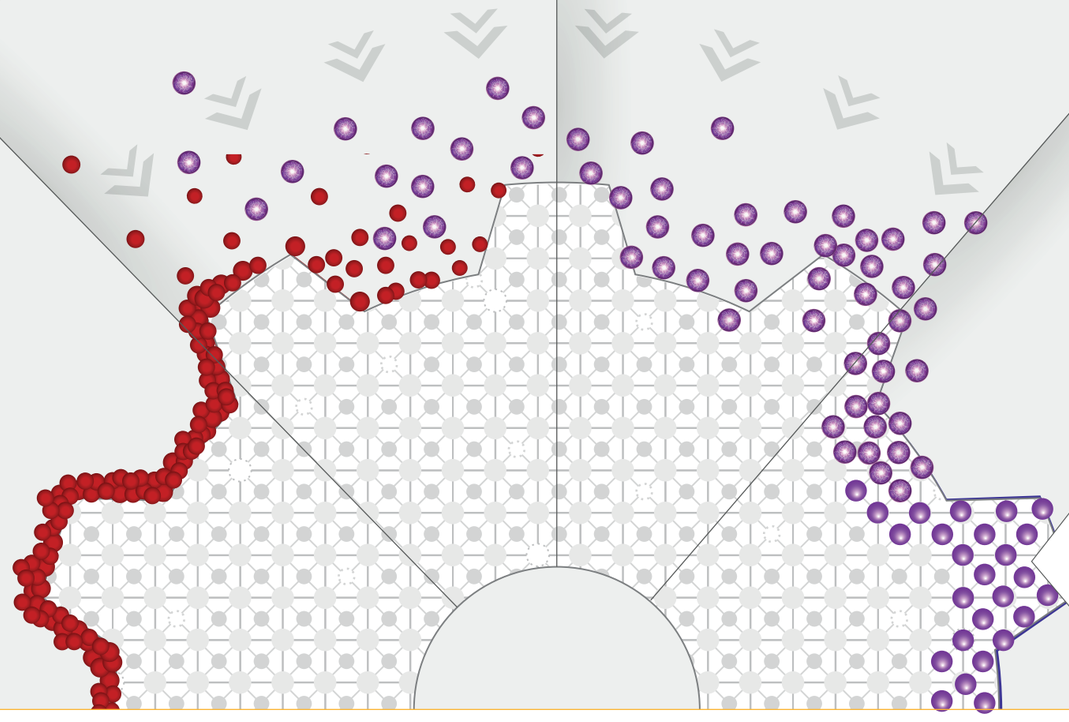
SPUTTERING

During plasma nitriding, ion bombardment removes iron oxides and other contaminants present on the surface of the part through an action known as sputtering or through a reductive reaction with hydrogen. This step is key to preparing the part's surface for better metallurgical results.

2

CASE FORMATION

As a result of the impact of ions and the presence of atomic nitrogen at the surface, the formation of the iron nitride (FeN) case begins. This occurs when the nitrogen ions are diffusing through the surface towards the core of the part.



3

FeN BREAKDOWN

The continuous bombardment of the plasma causes the instability of the FeN, which begins to break down, thus:

- $2FeN \rightarrow Fe_2N + N$
- $3Fe_2N \rightarrow 2Fe_3N + N$ (ε-phase)
- $4Fe_3N \rightarrow 3Fe_4N + N$ (γ' -phase)
- $Fe_4N \rightarrow 4Fe + N$ (Iron/nitrogen compound zone)

The result:

The result: a layer of iron, mainly (Fe_3N and Fe_4N), and other nitrides, which is a kind of ceramic mantle with low friction coefficient, higher corrosion resistance and high hardness.