

TRIBOMET[®] ABRASIVE COATINGS

The Technology

Praxair's TRIBOMET[®] coatings are electrodeposited composites which are applied by a patented process. They are produced when particles which are kept in suspension within an electroplating bath settle onto the component and are fixed by the depositing metal.

Abrasive coatings are produced when a monolayer of abrasive particles such as cBN are co-deposited in a thin adhesion (tack) layer of nickel. The cBN is then secured by an infill composite layer of either cobalt/chromium carbide (TBT406) or MCrAlY (TBT429 & TBT412). The latter is heat treated to form an alloy. See Fig.1 & 2 below.

TRIBOMET[®] Abrasive coatings are applied to rotating parts of gas turbine engines such as turbine or compressor blade tips or labyrinth seals. If contact between stator and rotor occurs the interaction between the abrasive and an abradable counter face coating can cut a machined gas path seal and also prevent the generation of thermally induced cracking of the rotor as a result of friction heating. This enables the designer to reduce the gap between the stator-rotor assemblies to improve fuel efficiency.

Typical Applications

Aerospace, Industrial Gas Turbines, Power Generation and Marine.

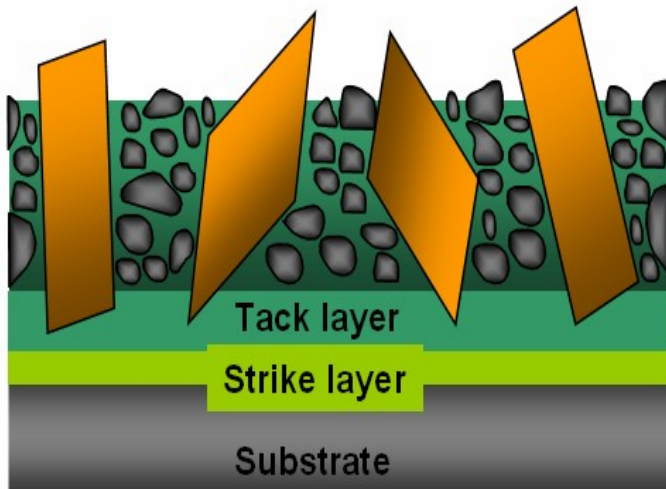


Fig. 1 A schematic showing the formation of TBT abrasive coating.

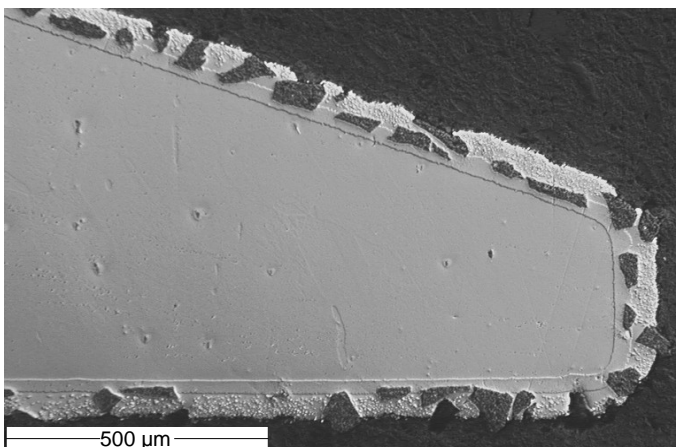


Fig. 2 TBT406 Cross Section

Coating Characteristics:

- **TBT406** – cBN 200/230 mesh, Cobalt Chrome Carbide infill, applied to labyrinth seals and compressor components. Operating temperatures are typically <700°C.
- **TBT412** - cBN 140/170 mesh, CoNiCrAlY bond coat & infill, applied to turbine tips & seals. Operating temperatures are typically 950°C.
- **TBT429** - cBN 100/120 mesh, NiCoCrAlY infill, applied to turbine tips. Operating temperatures are typically >1000°C.

Advantages

- Coatings can be applied to complex and critical areas accurately and repeatedly.
- Flexibility with a selection of abrasive materials of varying particle size and alloy matrices.
- Excellent adhesion >30,000 psi.
- Creates excellent seals against ceramic and metal counter faces.
- Coatings are 100% dense.
- Applied to low or high volume manufacture.
- No thermal distortion of component.
- Coatings with MCrAlY infill are diffusion heat treated over a wide range of temperatures – typically 1000 to 1150°C.

Praxair Partnership Approach

- Optimization of TRIBOMET® coatings are achieved when the coating has been “designed in”.
- The Weston facility is the home of PST’s Global TRIBOMET® Research and Development.
- Capable to support customer’s applications and discuss the possibilities for new coating chemistries.

Suitable Base Materials

- TRIBOMET® coatings can be applied to steels, aluminium, nickel and cobalt based alloys.
- Components can be cast, forged, rolled or extruded.

Flexibility of TRIBOMET® Abrasives Coatings

- The size of the co-deposited abrasive can be selected by the customer.
- Mesh sizes currently used in production are 60/80, 100/120,140/170 and 200/230.
- The selection of the infill layer is dependent upon the temperature of the application.

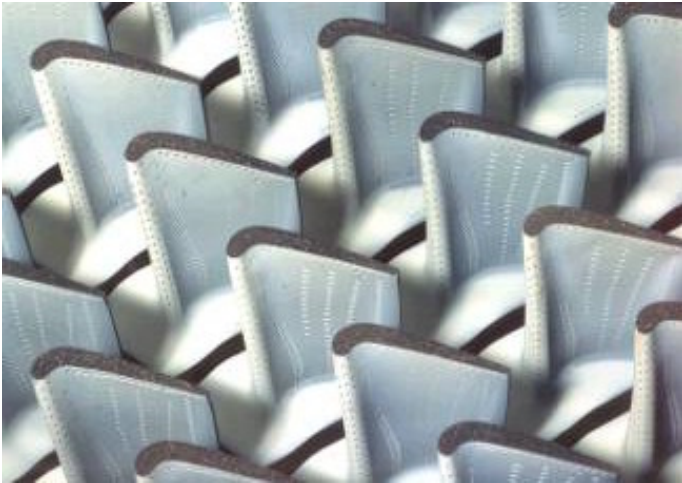


Fig. 4 Gas Turbine Blades coated with TRIBOMET® Abrasive Tip

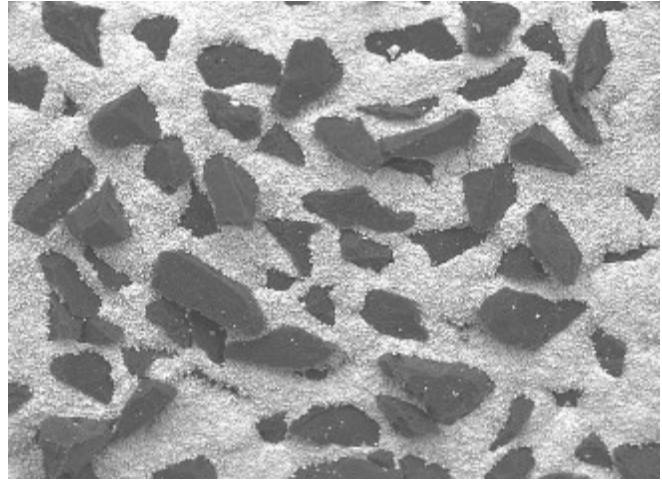


Fig. 5 Magnified Top View of TBT406

Quality Assurance and Approvals

Praxair Surface Technologies is committed to ensuring every product is made in accordance with our quality standards and our development and production partners:-

- Performance Review Institute – Aerospace Standard 9100 (PRI - AS9100).
- National Aerospace and Defense Contractors Accreditation Program (NADCAP).
- Rolls-Royce.
- General Electric (GE).
- British Aerospace (BAE Systems).
- Pratt & Whitney.
- Safran Group.