

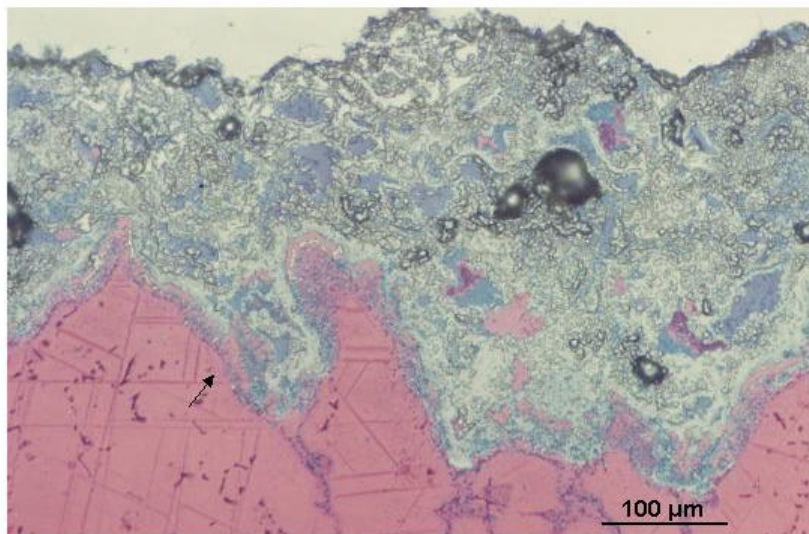


CONSULTING SERVICES IN GAS TURBINE METALLURGY AND MATERIALS

Turbotect provides a wide range of consulting services and on-site training in the metallurgical aspects of gas turbine technology. The services are designed to enable power plant operators to minimize operation and maintenance costs by considering various aspects of component life cycle engineering and materials selection.

Examples of services provided are as follows:

- **Investigation and metallographic examination** of used hot section components such as coated and uncoated blades, vanes and heat shields etc. This type of investigation enables the condition of components to be defined, with the aim of optimizing future operating and maintenance cycles.
In collaboration with independent laboratories and other qualified institutions, all state-of-the-art analysis and methods for examination of surfaces and metallographic sections are available.
Also, non-destructive replica metallurgical evaluation for part life assessments are offered by Turbotect. Together with the knowledge of the part history, this method allows estimation of the remaining expected life of the component or advice on its life extension.



- **Technical and commercial advice in the procurement of hot section parts** as related to materials selection and the definition of coating requirements as a function of fuel quality.
For example:
 - chemical composition of overlays
 - chemical composition of bond coats for thermal barrier coatings (TBC)
 - coating processes for overlays and TBCs
 - coating thickness and thickness distribution requirements for different components
 - coating processes for cooling hole protection (internal coatings)
 - sequence and method of drilling cooling holes if internal coatings are required

- **Establish specifications** according to customer requirements.
- **Definition of acceptance criteria** for coated components.
- **Quality assurance of coated parts** through process control, metallographic examination and non-destructive testing.
- **Advice on component refurbishment** by defining the commercial and technical features of available repair technologies and options. For example:
 - stripping method (chemical, mechanical, water jet)
 - rebuilt part shaping method (welding, brazing, VPS parent material deposition, laser cladding)
 - rejuvenation options (type of heat treatment and hot isostatic pressing HIP)
 - new coatings (see above)
- **Quality assurance of repaired parts**
- **Validation of new methods**
- **Validation of new partners**
- **Recommendations for hot section spare parts management**
- **Advice on "repair versus replacement" and upgrade options**
- **Individual on-site training**
 Turbotect offers individual training sessions shaped to the needs of your staff and at your facility. Subjects include, but are not limited to the above topics as applied to **materials, coatings and repair of hot section parts, technical and economical aspects.**
 The objective of the training provided is for your plant staff to gain a better and more detailed understanding of gas turbine materials, coatings and in state-of-the-art repair technologies.

Support in all of the above aspects of component life cycle engineering is based on Turbotect's long history and expertise in coatings and refurbishment of hot section parts, and enables gas turbine operators to achieve improved reliability and economic benefits.

REFERENCES: are available on request

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