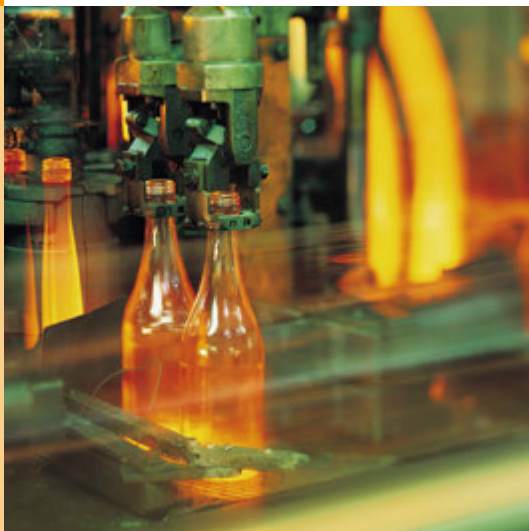




We create chemistry



BASF Fibro® Platinum Thermocouple Wire

Features & Characteristics

Overview

BASF's proprietary BASF Fibro® Platinum Thermocouple Wire provides increased high temperature strength and longer service life. This is achieved by retarding grain growth, and minimizing slippage, while retaining all chemical and thermo-electric properties of pure thermocouple grade Platinum. It's another example of our precious metals expertise.

It is recommended for use in thermocouples which are subject to abnormal handling or loading at temperature, such as in beaded assemblies used in profile and HIP applications.

BASF Fibro® Platinum enables:

- increased life of the thermocouple.
- reduced PM content of the thermocouple while retaining its performance.

Sample Material Testing

We have tested samples of standard thermocouple platinum wire and Fibro® Platinum Thermocouple Wire at 0.50 mm. These are a standard material used for manufacturing of thermocouples installed at high temperature in an industrial process.

Platinum wires, both Fibro® and standard, are thermocouple grade purity (better than 99,995%), are those commonly used as the negative (-) elements for thermocouples manufacturing.

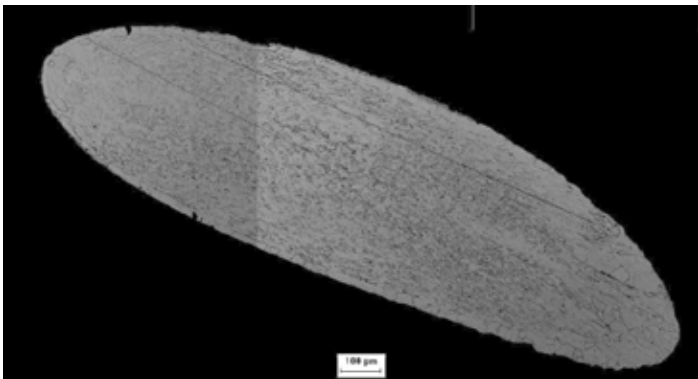
Metallographic Trials

Three different wires were analyzed, as listed below. Both used wires were exposed to the same conditions in customer's process at roughly around 1200C for 18 months.

1. New Fibro® Platinum wire never subject to any process conditions.
2. Used Fibro® Platinum sample subjected to thermal process conditions
3. Used standard platinum sample subjected to same thermal process conditions

Platinum NEW Fibro® Thermocouple Wire – Sample Trials

As shown below in the SEM images 1 and 2, grains appear small, fairly uniformly distributed, oriented and stretched along the drawing direction.



**Image 1 - SAMPLE "NEW Fibro®"
Longitudinal Section**

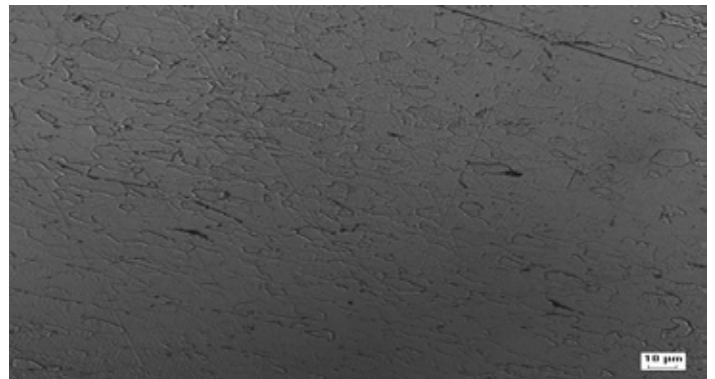


Image 2 - Magnified view of Image 1

This magnification shows clearly how the grain size is small and oriented along the wire drawing direction.

Fibro® Platinum Thermocouple Wire – Hot Sample Trial

The investigation then moved to observe the behavior of BASF's Fibro® Platinum Thermocouple Wire that was in the customer's process for 18 months and these are the results. Metallographic specimen were taken to show the grain size of the wire both on cross and longitudinal sections.

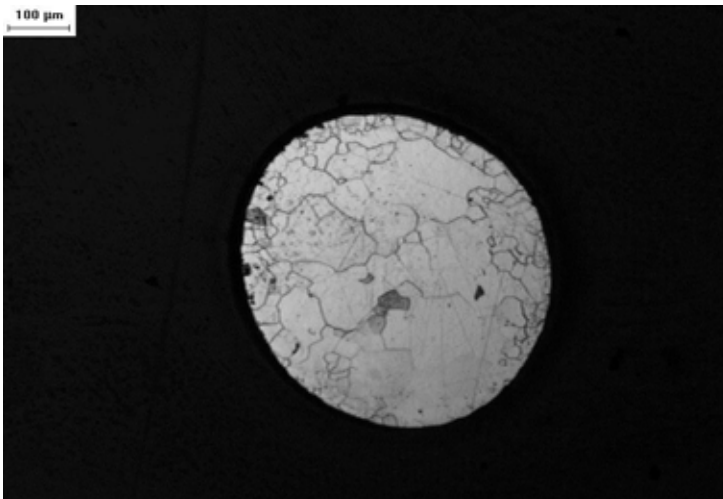


Image 3 - Cross section of a Fibro® Platinum (Pt) Wire after 18 months in process

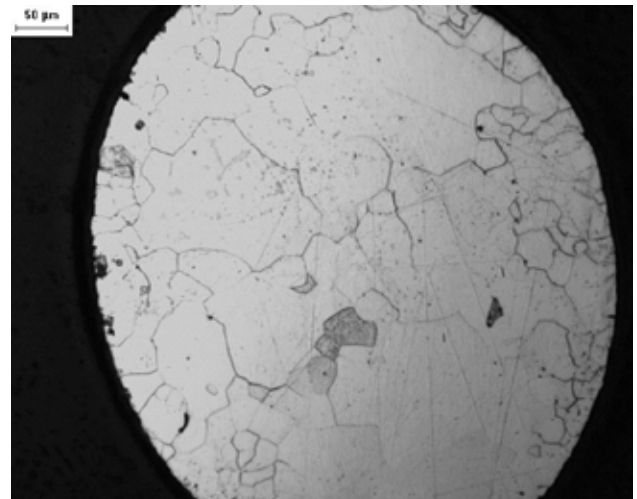


Image 4 – Magnified view of Image 3

Photos of the longitudinal section of the specimen were taken from different parts of the HOT sample to show the distribution of the grain size in a wider area. The results are shown in Images 5 to 10

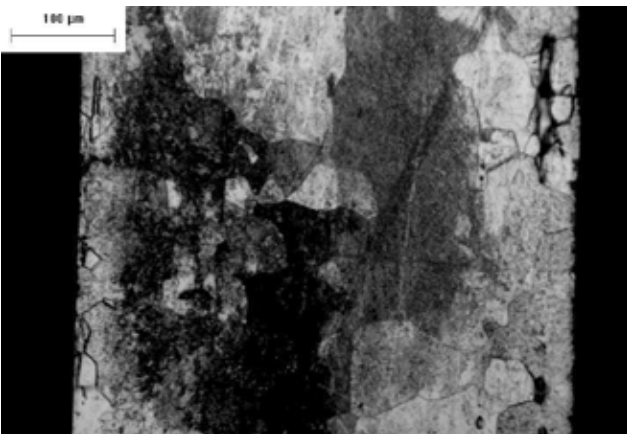


Image 5 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

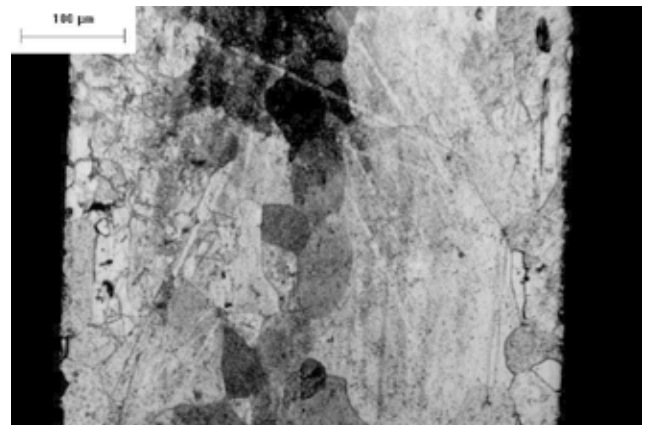


Image 6 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

BASF Fibro® Platinum Thermocouple Wire Features & Characteristics

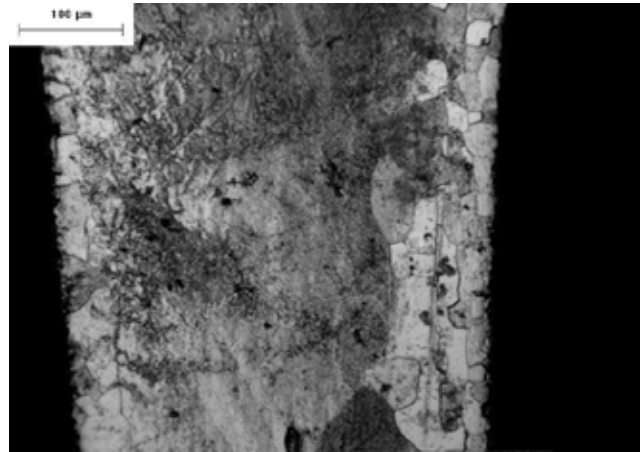


Image 8 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

Image 7 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

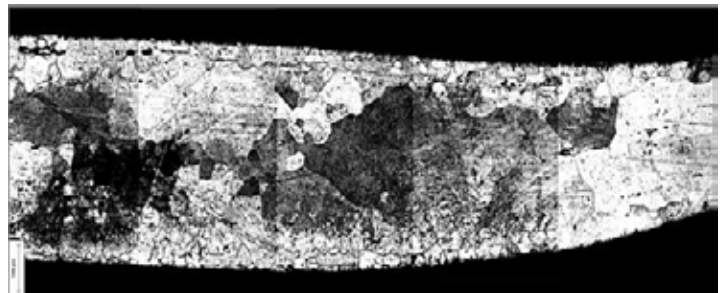


Image 10 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

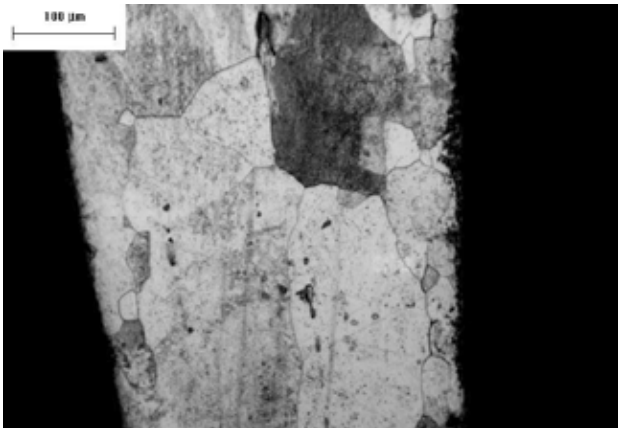


Image 9 - Longitudinal section of a Fibro® Pt Wire after 18 months in process

Image 10 is an edit of the previous 6 images to show the entire spectrum of the longitudinal section.

All images of the HOT sample show a reasonably fine grain size that has been kept during the 18 months in the customer process at 1200°C.

Standard Platinum Hot Sample Trial

Comparison with the standard platinum wire used in the same high temperature process can be seen in images below. The grain size of platinum is very large and taking the whole section of the wire, as it is fairly normal in the process conditions.



Image 11 - Longitudinal section of a standard Pt wire after 18 months in process



Image 12 - Longitudinal section of a standard Pt wire after 18 months in process

Other Considerations and Data

BASF has images from other used thermocouples and that show what can happen when the grain size is enlarging. This makes the wire mechanically weak and available to slip and break even when small mechanical stress is applied.

This phenomenon is common to all kind of metals and more evident when high purity metals are exposed for long time to high temperature above the recrystallization temperature, as it is the case of a thermocouple grade platinum where chemical purity is above 99.995%.

BASF Fibro® Platinum Thermocouple Wire Features & Characteristics



Image 13 - Grain size is 3-4 times bigger than the diameter of the wire



Image 14 - Crystallographic planes slippage

If the mechanical properties of platinum are higher, as it is with BASF Fibro® Platinum Thermocouple Wire, this will represent a safety factor for the thermocouple user– avoiding unforecasted open circuit in the thermocouple.

Conclusions

The outcome from the trials indicate that BASF Fibro® Platinum Thermocouple Wire clearly demonstrated that it can keep the grain size smaller than standard platinum for a longer time, when exposed to high temperatures.

Small grain size is a guarantee of better resistance to mechanical stress and resistance to corrosion or contamination that are important factors leading to a longer life of a thermocouple. This improves its reliability and reducing the risk of open circuits. Customer data also indicates that the lifetime of thermocouples have been considerably increased by using BASF Fibro® Platinum Thermocouple Wire in their processes.

BASF Fibro® Platinum Thermocouple Wire is an example of our mandate to offer value-added products that help improve their process yield while reducing the cost of ownership to our customers.

About BASF's Temperature Sensing Products

For over 30 years, BASF has supplied a wide range of industries, including semiconductor, glass, solar cell, chemical, crystal growth, heat treating, laser welding, gas turbine, biomedical, and others with exceptionally high quality temperaturesensing products and temperature sensor calibration services to meet the demanding applications of our customers.

Metals - particularly those in the platinum group- are critical components of many products made by BASF such as contact thermocouples. The experience of our research and development group in precious metal and precious metal technologies is unmatched. From Fibro® platinum to Platinel® thermocouple wire, we have led the industry with breakthrough innovations. No one knows more about precious metals. Further information on BASF's Temperature Sensing products are available on the Internet at www.catalysts.basf.com/tempsensing.

About BASF's Catalysts Division

BASF's Catalysts division is the world's leading supplier of environmental and process catalysts. The group offers exceptional expertise in the development of technologies that protect the air we breathe, produce the fuels that power our world and ensure efficient production of a wide variety of chemicals, plastics and other products. By leveraging our industry-leading R&D platforms, passion for innovation and deep knowledge of precious and base metals, BASF's Catalysts division develops unique, proprietary catalyst and adsorbent solutions that drive customer success. Further information on BASF's Catalysts division is available on the Internet at www.catalysts.basf.com.

About BASF

At BASF, we create chemistry – and have been doing so for 150 years. Our portfolio ranges from chemicals, plastics, performance products and crop protection products to oil and gas. As the world's leading chemical company, we combine economic success with environmental protection and social responsibility. Through science and innovation, we enable our customers in nearly every industry to meet the current and future needs of society. Our products and solutions contribute to conserving resources, ensuring nutrition and improving quality of life. We have summed up this contribution in our corporate purpose: We create chemistry for a sustainable future. Further information on BASF is available on the Internet at www.basf.com.

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