NON DESTRUCTIVE TESTING OF TURBINE BLADE BY X-RAY DIFFRACTION

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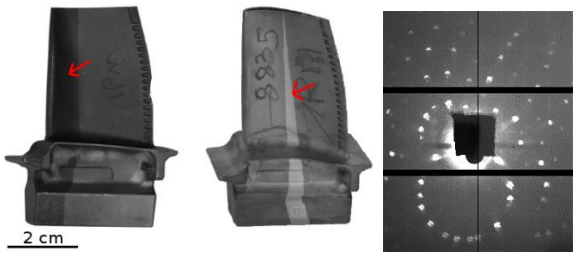

Turbine blade with crystalline defects & Transmission Laue pattern

- Application of the Laue transmission method ;
- Determination of orientation and quality of single crystals ;
- Detection of crystalline defects ;
- Nickel superalloy for high pressure turbine blade.

Abstract:

Safran Aircraft Engine (SAE) is the Safran Group's company specialized in the design and manufacture of turbojet engine for civil and military aircraft. This PhD study is performed with Safran Tech research center for the needs of SAE. The field of study concerns high pressure turbine blades.
The high pressure turbine is the second part of the turbojet hot section, behind the combustion chamber. The turbine consists of several compression levels made of monocrystalline nickel superalloy blades. The monocrystalline structure is obtained by directional solidification casting, by lost-wax process. During the blade manufacturing process, crystalline defects can appear leading to multi grain structured blade rather than a monocrystal piece.

The current non-destructive testing involves manual detection of external grains followed by crystal orientation measurement by back-reflection method of Laue diffraction. Because of the complexity of the blade geometries with several walls and cavities, a new X-ray system is developed, based on transmission method of Laue diffraction. Using a transmission method allows to go through all the cavities of the blade to probe each walls.

A blade diffraction pattern generated by a polychromatic X-ray beam is given to this new system. The diffraction pattern is used to identify the blade crystalline orientation and, track defects by detecting a second orientation.