# PILATUS3 R CdTe
# Inspecting monocrystalline turbine blades via transmission Laue diffraction

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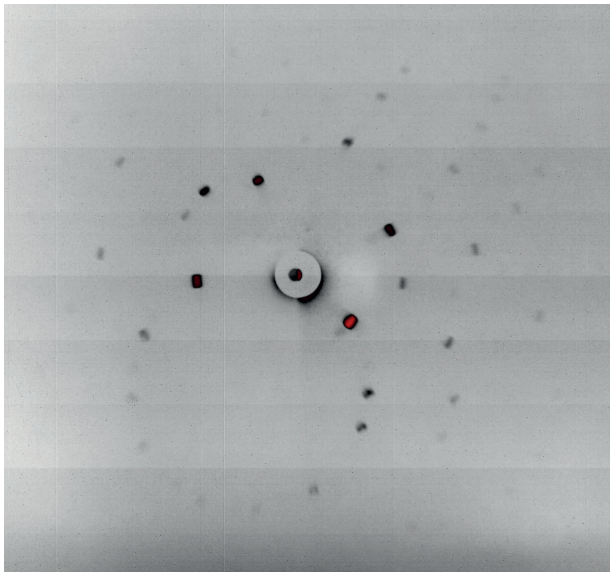
## Introduction

The PILATUS3 CdTe Hybrid Photon Counting (HPC) detector was used for Laue testing of single crystal alloys in transmission geometry. The results demonstrate the feasibility to test thicker samples and an increase in testing speed by a factor of 5 compared to conventional detector technology.

In HPC detectors, each pixel is its own detector equipped with a dedicated threshold to reject noise and low energy X-rays. This allows each pixel to digitally count the number of detected X-rays. HPC detectors acquire images noise free, with unlimited dynamic range and a single-pixel point spread function.

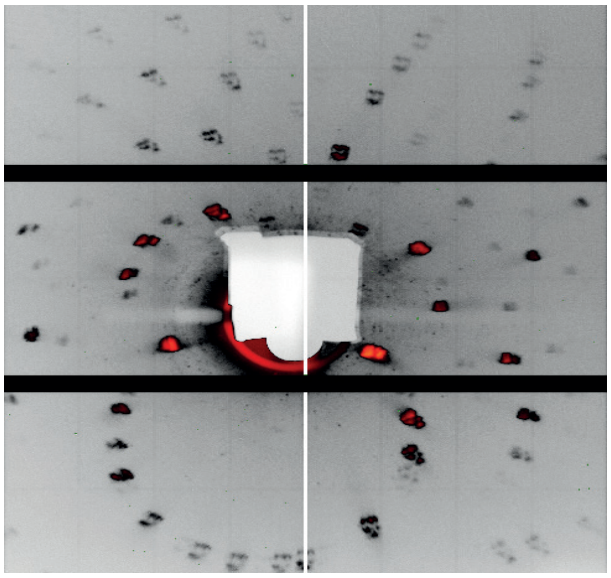

*PILATUS3 R 300K CdTe HPC detector.*

## Conventional integrating indirect detector versus PILATUS3 R CdTe detector



*Conventional detector: Laue pattern of aircraft blade made of AM1 alloy. Image shown with colors to extend dynamic range. Red pixels show increased count values.*

PILATUS3 CdTe data requires 5x less X-ray signal to provide adequate images for analysis and allowing to screen thicker materials [1].



*PILATUS3 detector: Laue pattern of aircraft blade made of AM1 alloy. Image shown with colors to extend dynamic range. Red pixels show increased count values, but do not indicate saturation.*

Application Note

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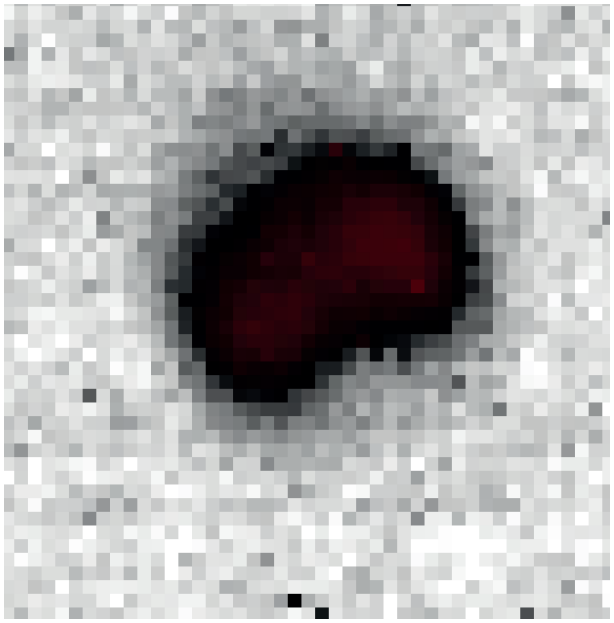

*Recorded with conventional detector*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 5676 | 5592 | 5624 | 5624 | 5696 | 5708 | 5696 | 5656 | 5768 | 5668 |
| 5596 | 5604 | 5672 | 5564 | 5664 | 5668 | 5700 | 5620 | 5608 | 5704 |
| 5644 | 5564 | 5576 | 5592 | 5704 | 5592 | 5640 | 5552 | 5580 | 5732 |
| 5620 | 5660 | 5656 | 5596 | 5840 | 5700 | 5804 | 5704 | 5672 | 5664 |
| 5668 | 5632 | 5656 | 5596 | 5596 | 5660 | 5708 | 5664 | 5716 | 5676 |
| 5712 | 5652 | 5600 | 5552 | 5712 | 5672 | 5672 | 5608 | 5720 | 5708 |
| 5600 | 5620 | 5664 | 5608 | 5672 | 5612 | 5716 | 5628 | 5664 | 5624 |
| 5620 | 5688 | 5648 | 5656 | 5708 | 5608 | 5700 | 5652 | 5684 | 5728 |
| 5508 | 5620 | 5676 | 5576 | 5644 | 5624 | 5608 | 5620 | 5676 | 5636 |
| 5616 | 5580 | 5636 | 5572 | 5668 | 5624 | 5612 | 5704 | 5756 | 5592 |

*Recorded with conventional detector*

Due to direct detection, PILATUS3 CdTe data shows sharper peaks with detailed structure. Red is used to indicate increased count value and does not indicate saturation.

PILATUS3 CdTe data show spots which are hidden by electronic noise in images taken with conventional detectors.

*Recorded with PILATUS3 detector*

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1354 | 1308 | 1231 | 1099 | 1095 | 1103 | 1213 | 1238 | 1155 | 1169 |
| 1199 | 1210 | 1194 | 1186 | 1224 | 1114 | 1241 | 1249 | 1197 | 1163 |
| 1245 | 1330 | 1323 | 1255 | 1123 | 1136 | 1288 | 1314 | 1201 | 1244 |
| 1235 | 1310 | 1464 | 1270 | 1199 | 1265 | 1321 | 1296 | 1223 | 1117 |
| 1258 | 1320 | 1487 | 1545 | 1350 | 1468 | 1512 | 1524 | 1306 | 1125 |
| 1245 | 1363 | 1310 | 1597 | 1669 | 1591 | 1527 | 1430 | 1304 | 1180 |
| 1305 | 1373 | 1376 | 1423 | 1488 | 1405 | 1385 | 1252 | 1192 | 1133 |
| 1206 | 1408 | 1252 | 1281 | 1405 | 1306 | 1259 | 1271 | 1185 | 1081 |
| 1086 | 1337 | 1206 | 1211 | 1241 | 1292 | 1159 | 1138 | 1154 | 1069 |
| 1185 | 1182 | 1218 | 1253 | 1230 | 1241 | 1257 | 1138 | 1281 | 1094 |

*Recorded with PILATUS3 detector*


References

[1] Arnaud, A. *et al.*, "Nondestructive testing of single crystal alloy by X-ray diffraction", *Procceedings of Nondestructive Evaluation of Aerospace Materials and Structures*, 2018

[2] T. Donath *et al.*, "Characterization of the PILATUS photon-counting pixel detector for X-ray energies from 1.75 keV to 60keV" *J. Phys.: Conf. Ser.*, 2013


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