

Identifying Sources of Low-Spatial Frequency Figure Errors in Full-shell X-Ray Optics

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Overview

NASA Marshall Space Flight Center fabricates electroformed mirror shells for astronomical **x-ray telescopes**.

Shells are formed around a mandrel, but have surface figures that deviate from the mandrel.

These figure errors degrade shell performance.

By investigating fabrication parameters, sources of figure error can be identified.

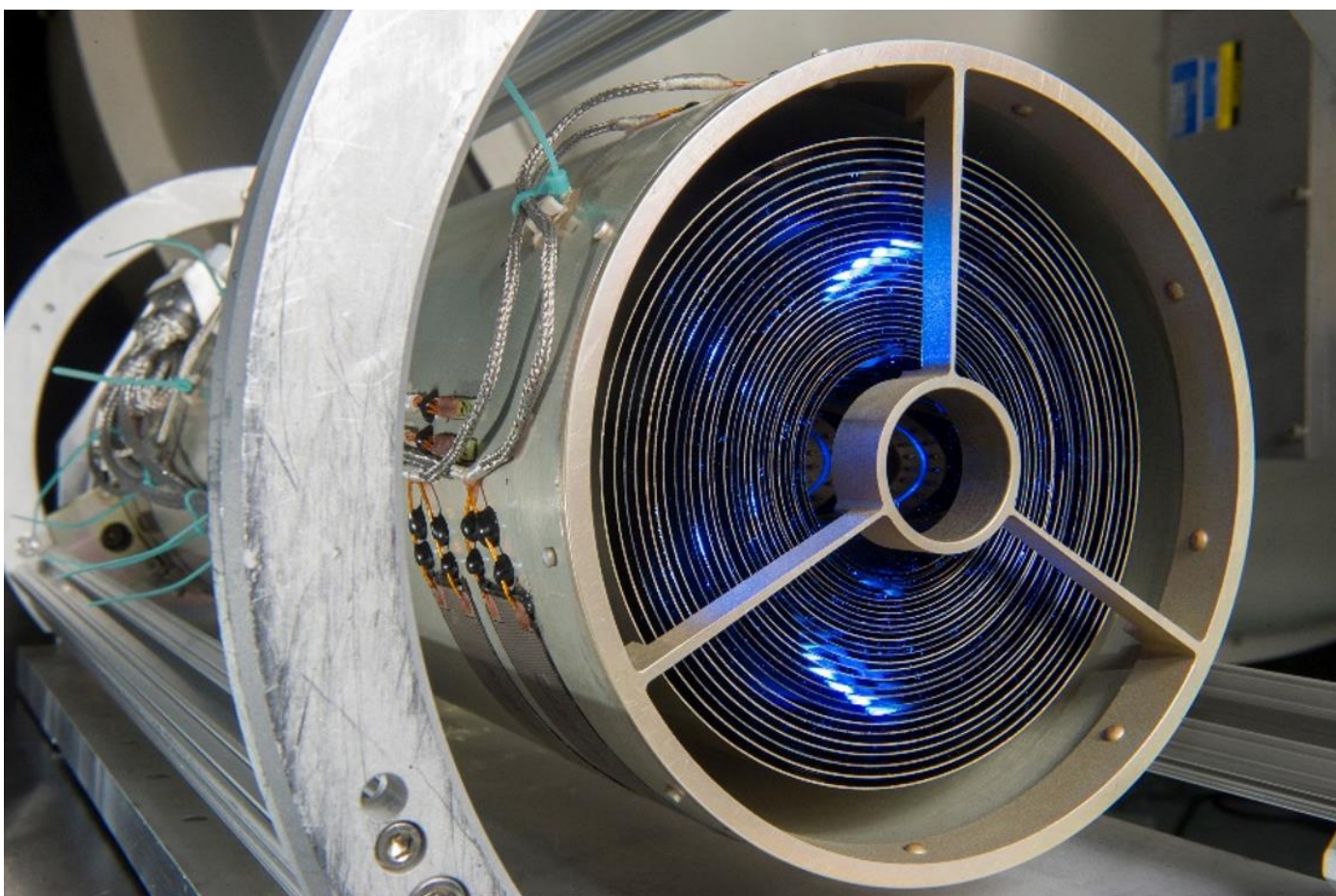


Figure 1: Full nested shell assembly for x-ray telescope



Figure 2: X-ray mirror shell fabrication process

Experiment

Investigate different parameters in manufacturing process!

Four different experimental shell types were scanned:

- Thicker shells
- Low plating stress during replication
- High plating stress during replication
- Slowly cooled during separation

Control set includes shells made with the standard manufacturing process.

Acknowledgements

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Measurements

Scans were completed using the Vertical Long Trace Profilometer, or VLTP. The VLTP measures surface profile along reflecting surface of shell.

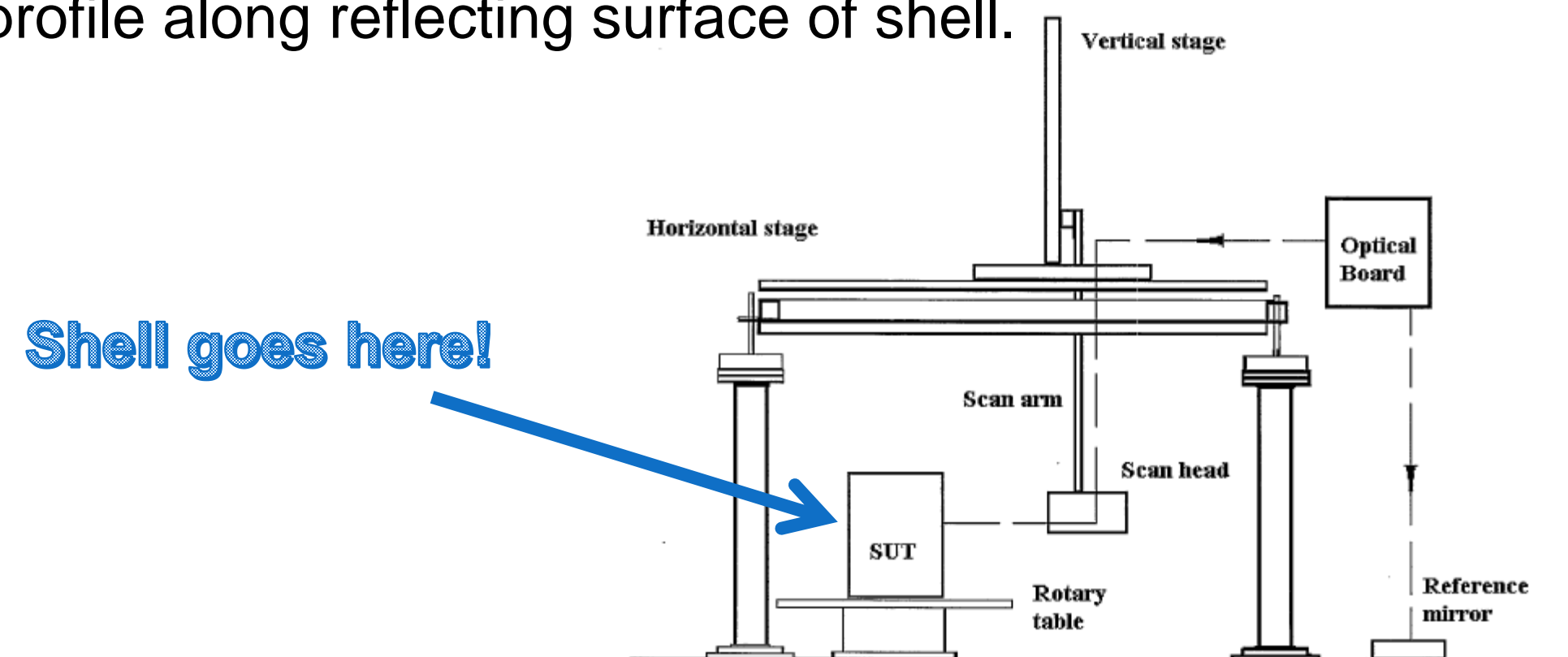


Figure 3: Diagram of VLTP

Results

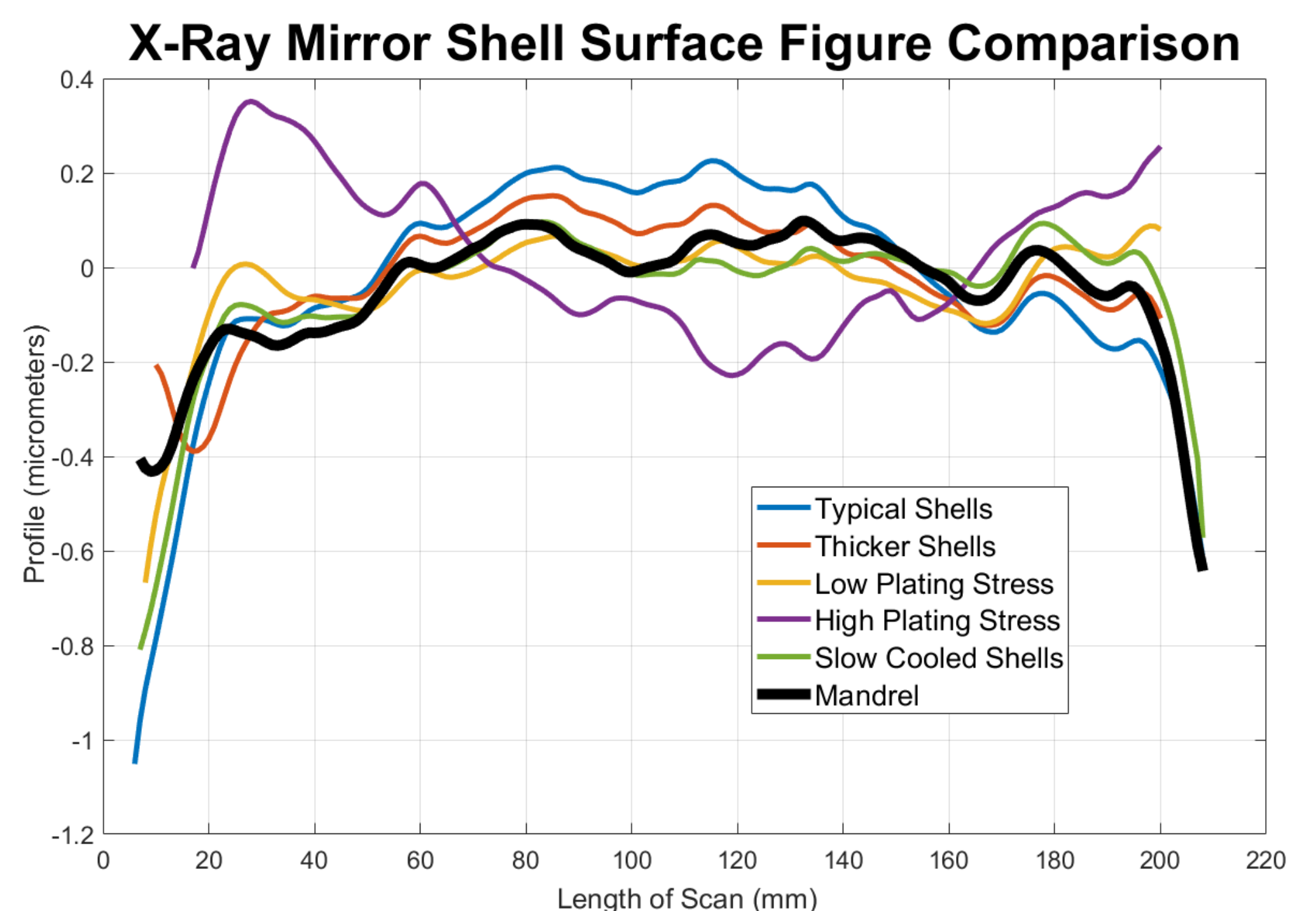


Figure 4: Shell experiment results

Figure 4 displays surface figures for the parabolic ends of the experimental shell sets and the mandrel.

Slowly cooled and **low plating stress** x-ray mirror shells produced the smallest deviation from the mandrel.

Impact/Conclusions

Slowly cooling shells after electroplating can reduce the surface figure error in x-ray mirror shells.

Refining the manufacturing process can help decrease surface figure error and improve the performance of the grazing incident x-ray optics for better astronomical data.

Current studies will be used to improve shells for the IXPE (**I**maging **X**-Ray **P**olarimetry **E**xplorer) mission.

