

# Shot Peening Process Optimized for Nitinol Medical Devices

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# Overview

Introduction

Shot Peening Basics

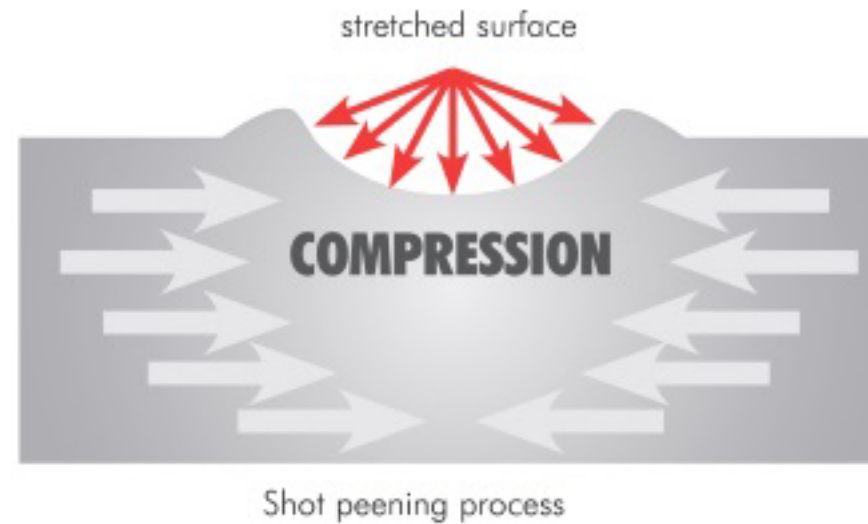
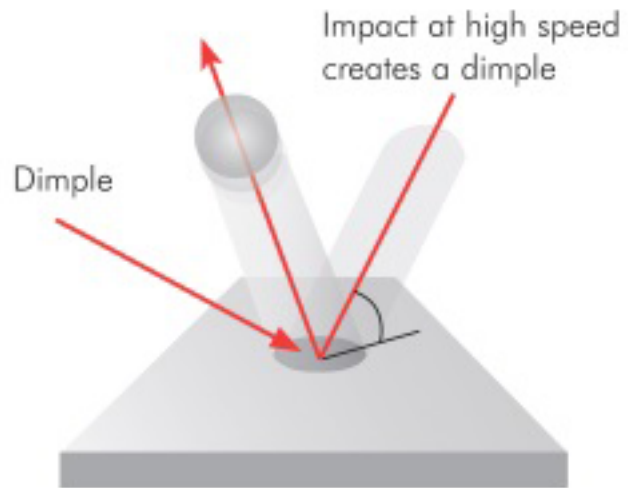
Our Experiment

Results

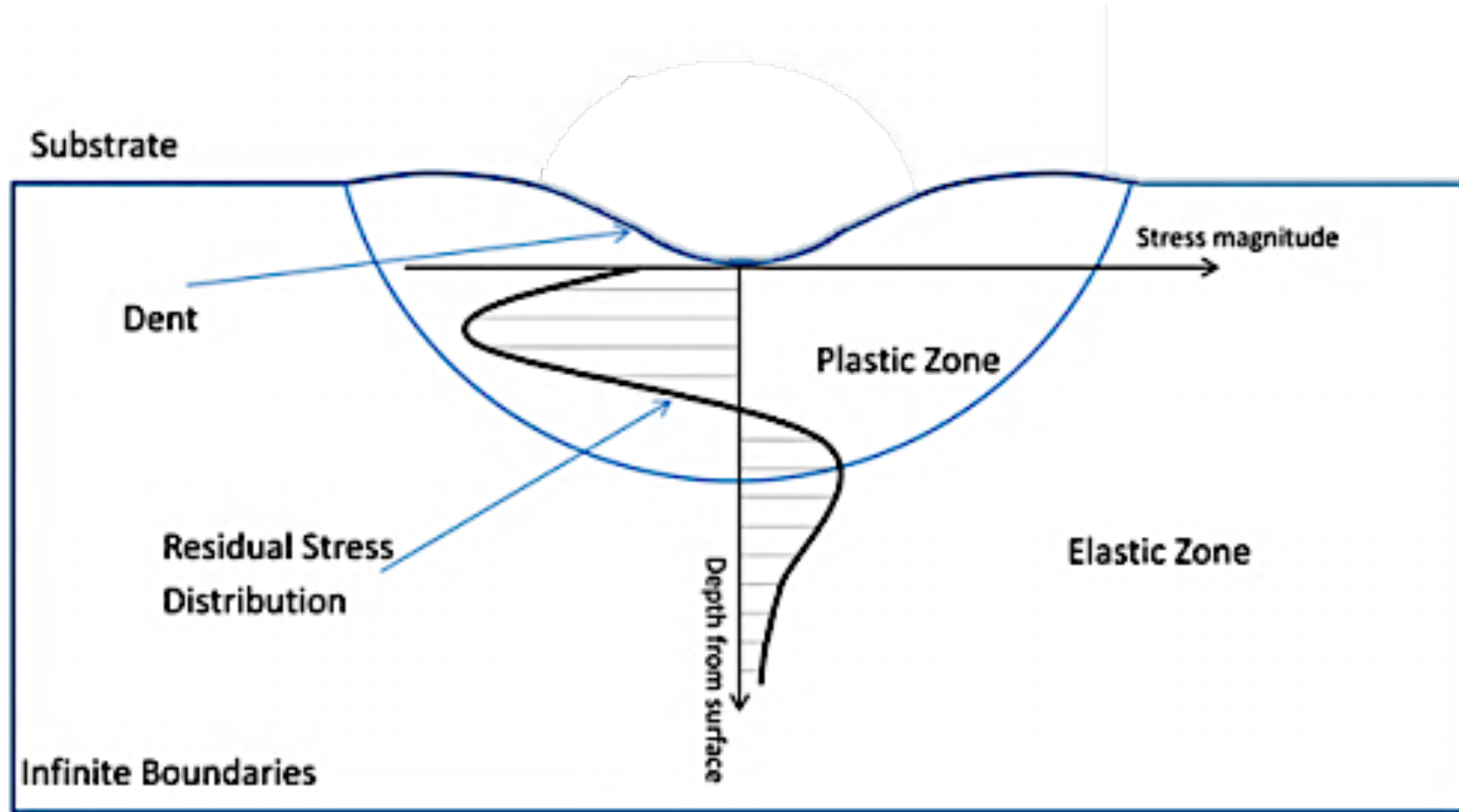
Conclusion

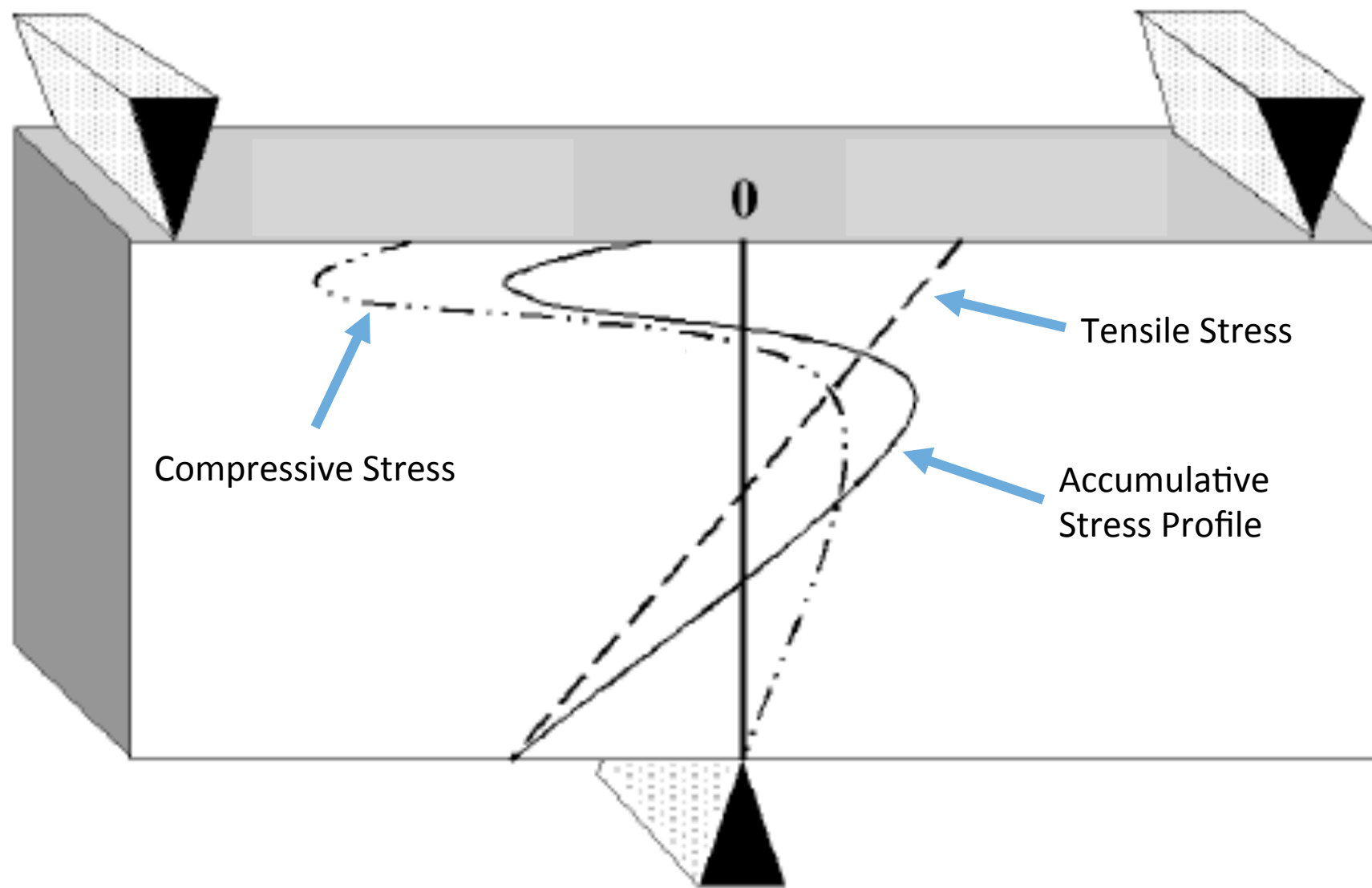
Questions

# Shot Peening Basics



# Shot Peening Basics





# Shot Peening Applications



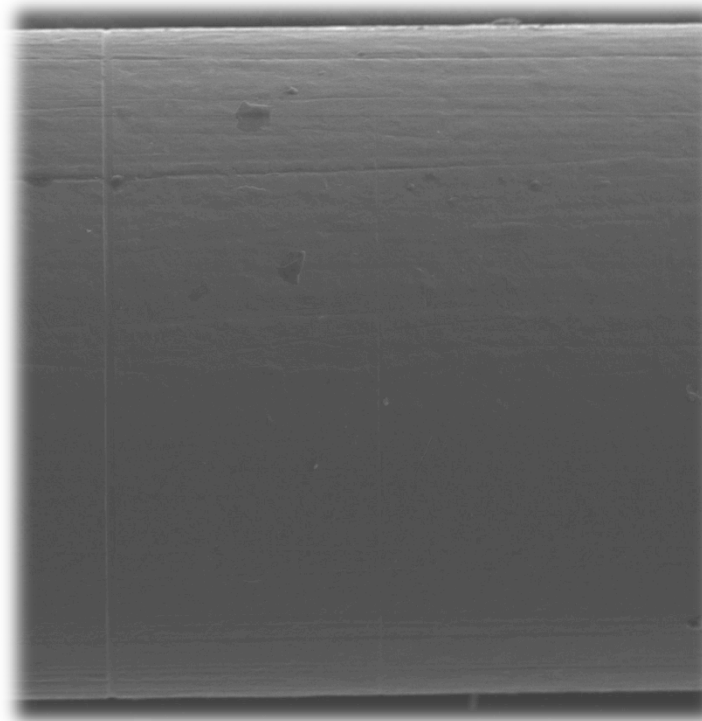
# The Million Cycle Question...

Can shot peening be used to improve the fatigue properties of Nitinol medical devices without sacrificing biocompatibility?



# Our Experiment

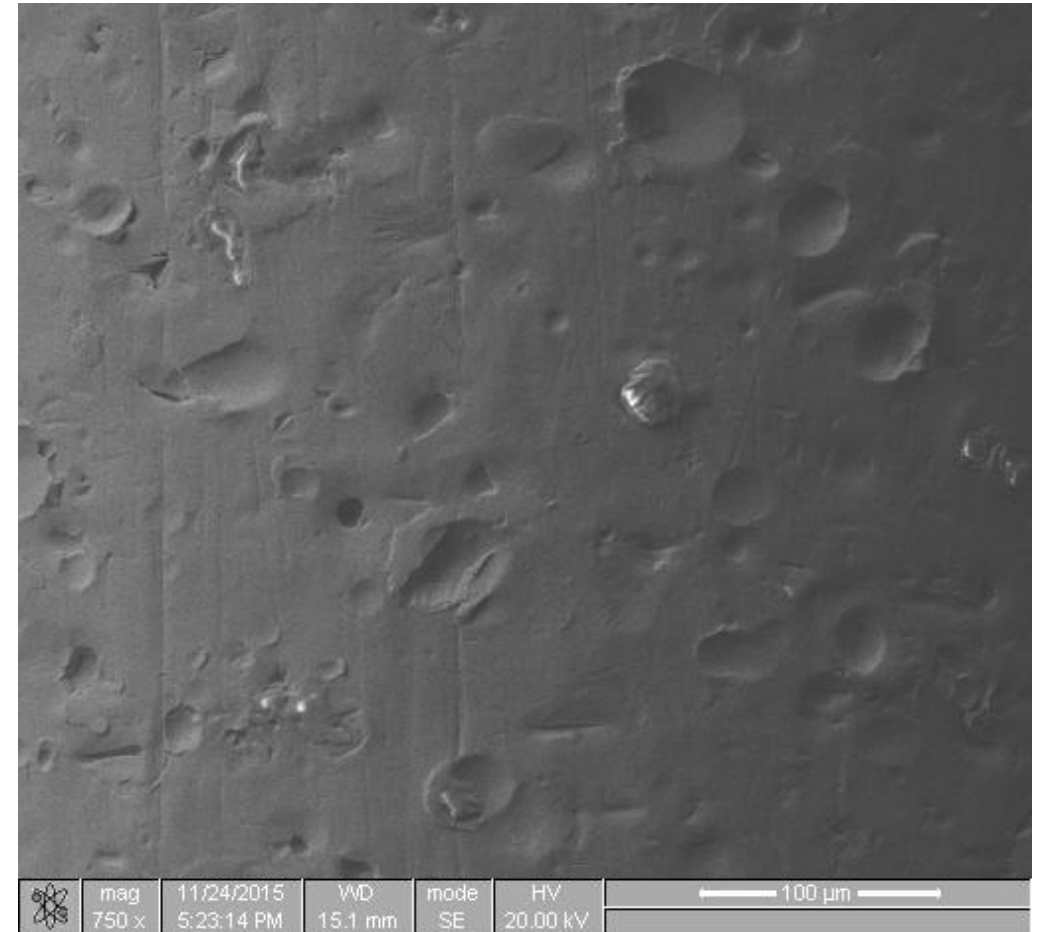
- Material Tested:
  - SE508 Nitinol wire
  - Diameter: 0.600mm
  - Ground surface
- Peening Media:
  - Biocompatible Ceramic Media
  - Particle Size Range: 150-210 $\mu$ m
  - Shape: Spherical
- Subsequent Surface Processing:
  - Electro Polished then Peened Surface
  - Peened then Electro Polished
    - 0.025mm Material Removal
    - 0.038mm Material Removal
    - 0.051mm Material Removal



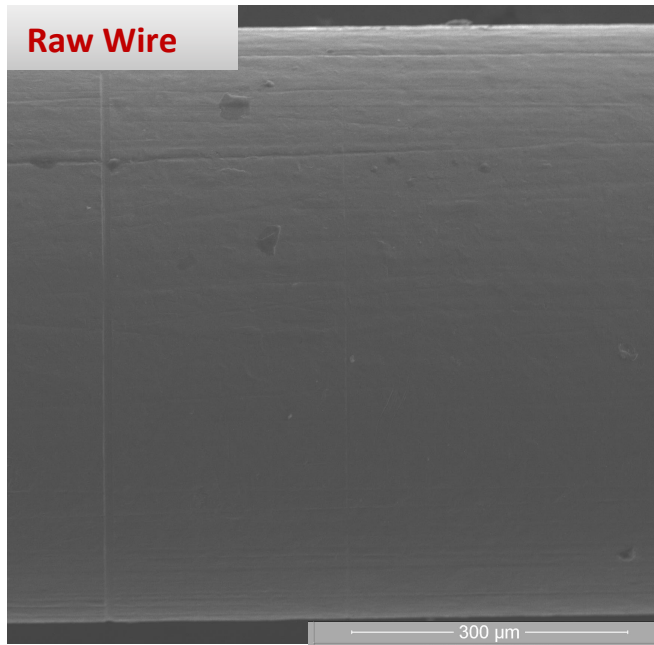


# Testing Methods

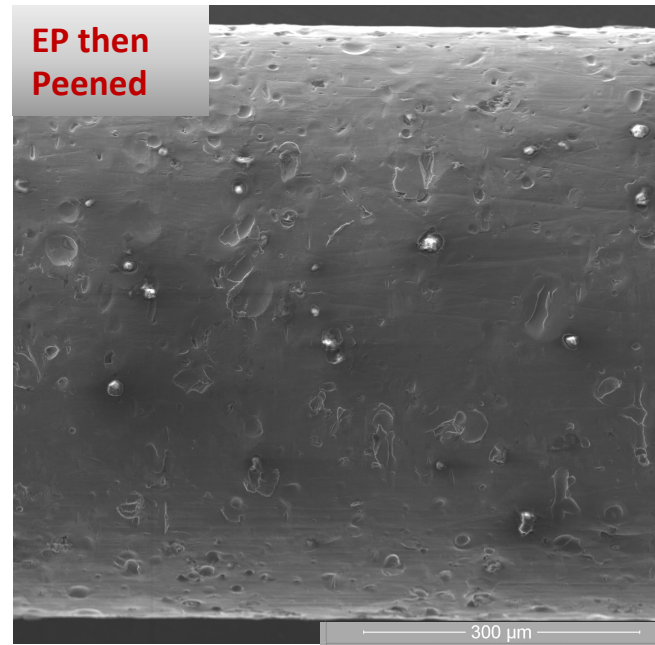
- Rotary Bend Fatigue Testing
  - Strain: 1%
  - Testing Media: Water 37°C
- Corrosion Testing
  - Per ASTM F-2129
- SEM Imaging of Surface Quality
- EDAX Analysis of Surface Chemistry
- Nickle Ion Release Testing



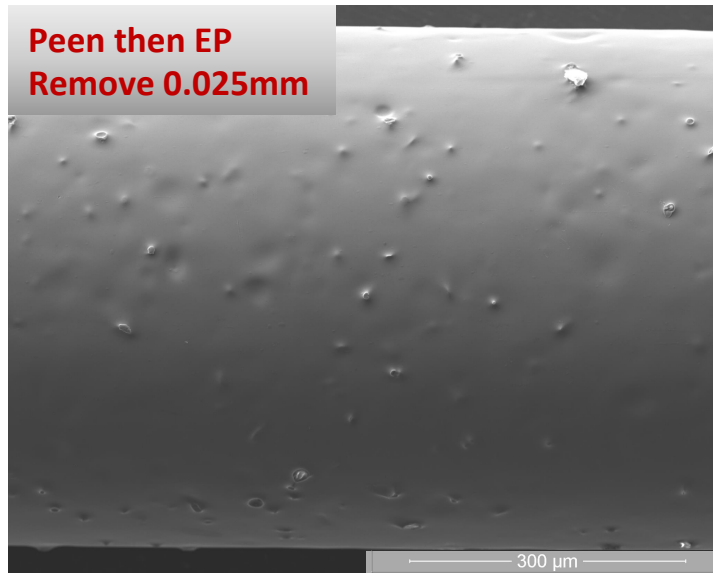
**Raw Wire**



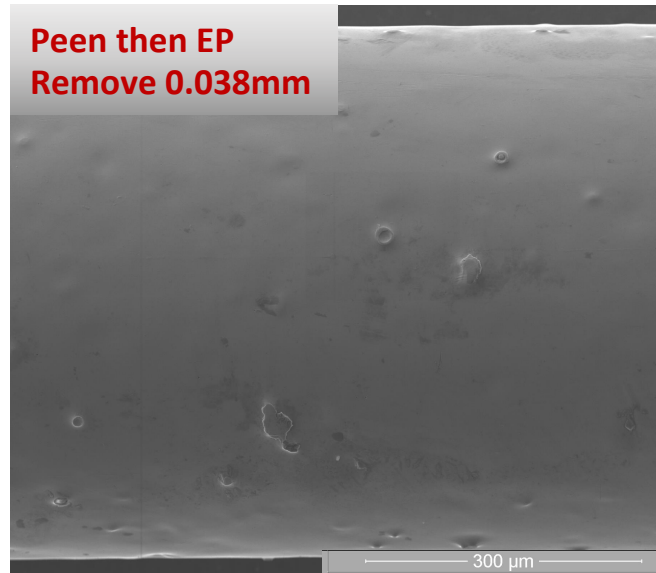
**EP then  
Peened**



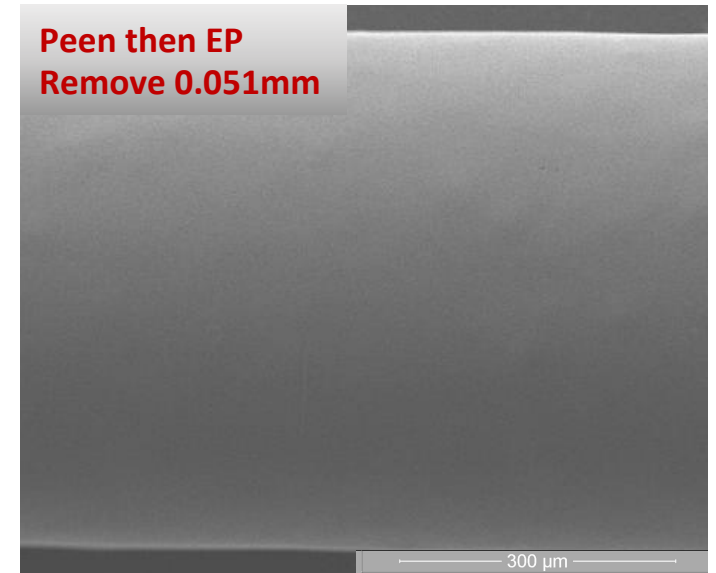
**Peen then EP  
Remove 0.025mm**



**Peen then EP  
Remove 0.038mm**



**Peen then EP  
Remove 0.051mm**



A scatter plot showing the relationship between surface finish process and fatigue life (Cycles to Break). The x-axis is logarithmic, ranging from 1,000 to 1,000,000 cycles. The y-axis lists five surface finish processes. Data points are color-coded: black for peened processes, green for electro polished then peened, and blue for electro polished. A vertical line at 1,000,000 cycles indicates the test limit.

Surface Finish Process	Cycles to Break (Approximate)
Peened then Remove .051mm	15,000, 25,000, 28,000, 30,000, 35,000, 40,000, 220,000
Peened then Remove .038mm	450,000, 500,000, 600,000
Peened then Remove .025mm	1,000,000
Electro Polished then Peened	1,000,000
Electro Polished	10,000, 11,000, 12,000, 13,000, 14,000, 15,000, 16,000, 17,000, 18,000

# Corrosion Data

Surface Preparation	Resting Potential (mV)	Break Down Potential (mV)
Electro Polished Wire	84	1050
Electro Polished Wire	87	1050
Electro Polished then Peened	49	353
Electro Polished then Peened	61	246
Peened then EP Remove 0.025mm	5	1090
Peened then EP Remove 0.025mm	24	1090
Peened then EP Remove 0.038mm	63	1070
Peened then EP Remove 0.038mm	84	1060
Peened then EP Remove 0.051mm	74	1060
Peened then EP Remove 0.051mm	80	1050

Corrosion Resistance Key*	
Unacceptable Resistance	<300mV
Marginal Resistance	300-600mV
Optimum Resistance	>600mV

# Conclusions

- Shot peening improves the fatigue performance of Nitinol Wire
- Biocompatibility concerns can be addressed using subsequent processing

## Next Steps

- Investigate depth profile of residual stresses
- High cycle fatigue and investigate different strain levels
- Investigation of more complex devices
  - Laser cut stents
  - Thin components

**Questions?**

[bit.ly/smst17ndc](http://bit.ly/smst17ndc)

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