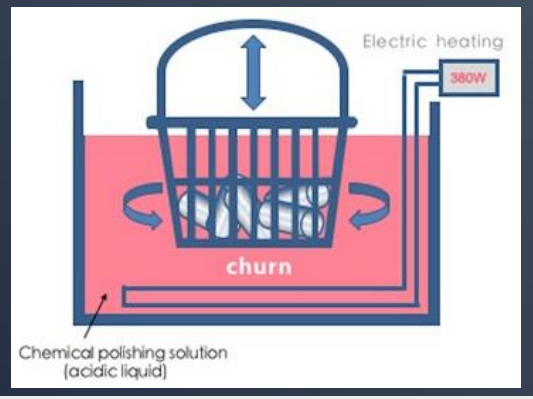
Plasma Polishing Technology

08/01/2021

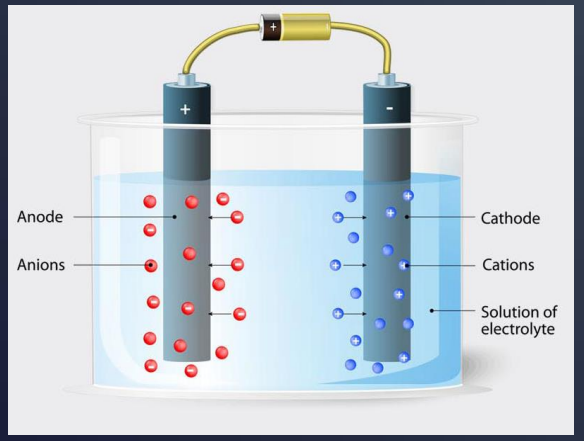
Traditional polishing process

- **Mechanical polishing**
  - Polish the metal surface by mechanical tools

- **Chemical polishing**
  - Polish the metal surface by chemical reaction



- **Electrochemical polishing**
  - Polish the metal surface by anodic dissolving

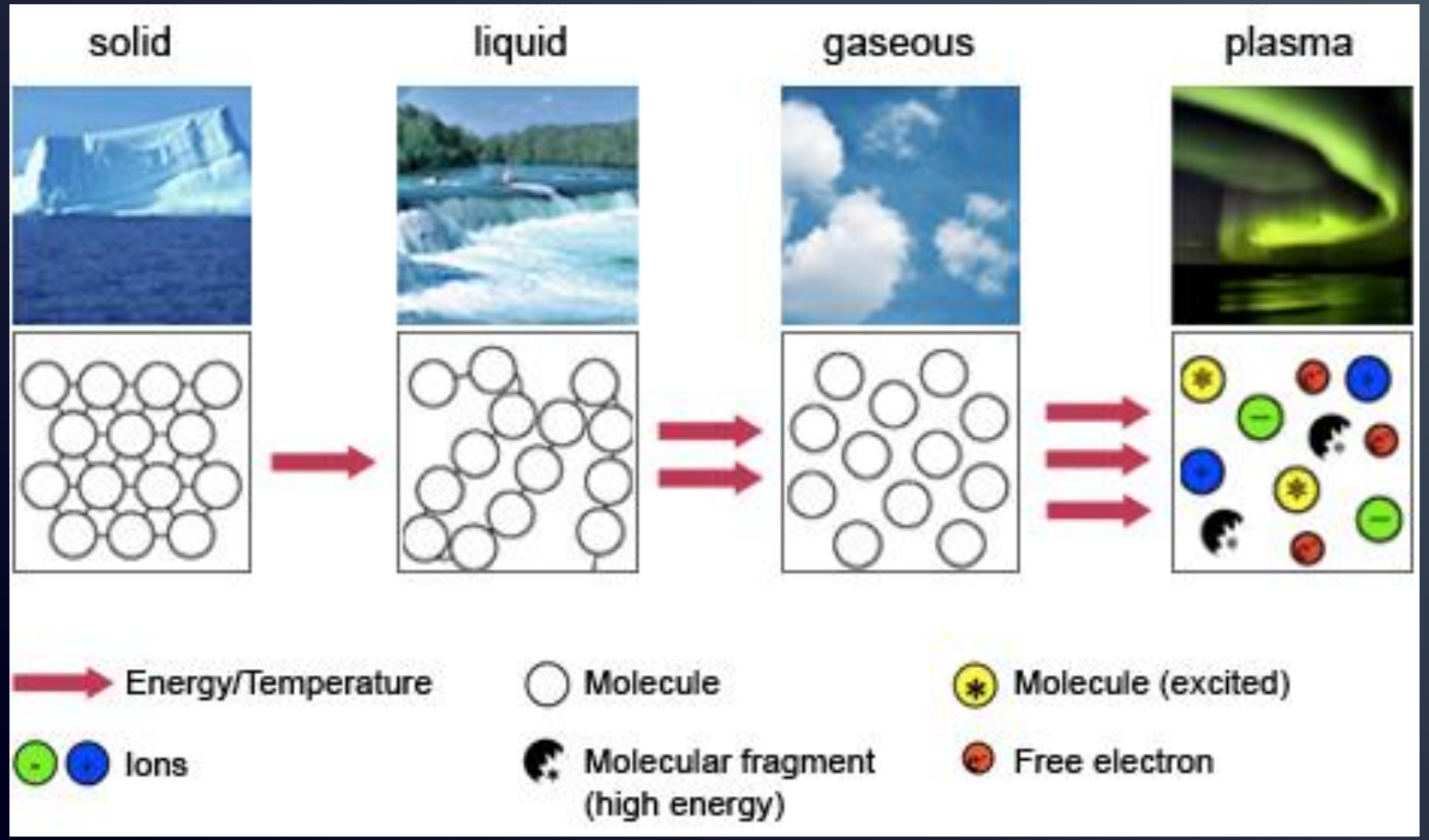


Limitations of traditional polishing process

- **Mechanical polishing**
  - Simple objects
  - Labor intensive/low efficiency
  - Dust explosion
- **Chemical polishing**
  - Poor uniformity of the gloss
  - Fire hazard
  - Expensive post-treatment of chemical solutions
- **Electrochemical polishing**
  - Corrosion of the polishing machines
  - Expensive post-treatment of polishing solutions
  - Poor dimensional tolerance



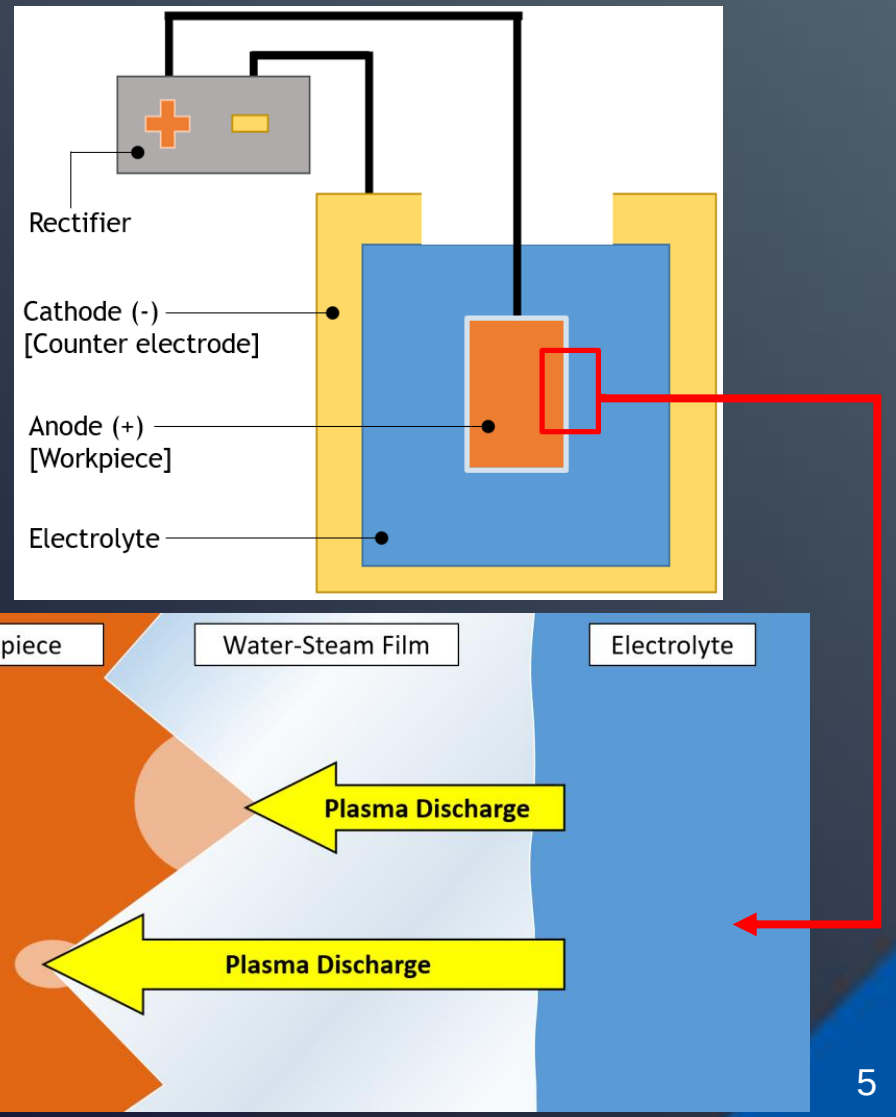

What is plasma



Design of multi-stage plasma polishing process

❖ Operation process

- 1st
  - Pre-treatment of the metallic object
- 2nd
  - Immerse the metallic object into the polishing solution
- 3rd
  - Gas film formed on the surface of the metallic object under high voltage
  - Plasma discharged on the surface of the metallic object



Design of multi-stage plasma polishing process

❖ **Plasma polishing machine**

- **Rectifier**
  - **Provide high voltage**
- **Adjustable cathode**
  - Distance-adjustable octagonal cathode
- **Anode with workpiece fixer**
  - Fix the metallic object on the anode
- **Polishing tank**
  - Excellent chemical and thermal stability
- **Washing tank**
  - Post-treatment of metallic object

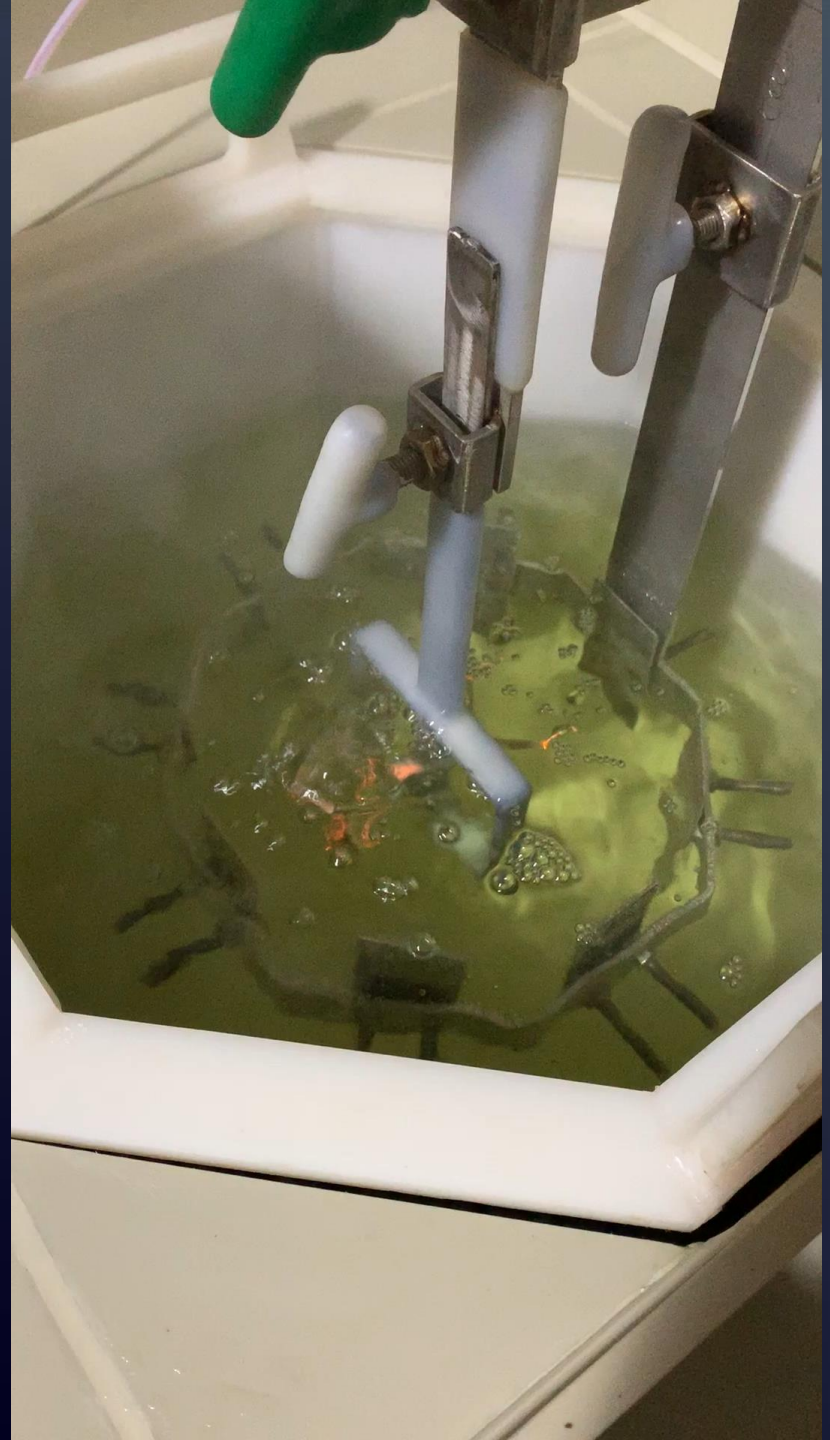
Parameters of the plasma polishing process

Parameters

- Applied voltage: 300~600V
- Temperature of the polishing solution: 50-80 ℃
- Polishing time: 1-6 min
- Material of the metallic object: metal or metal alloy
- pH of the polishing solution: 5-7
- Distance between electrodes: 1-10 cm
- Area ratio of metallic object and cathode: 1:1 to 1:50

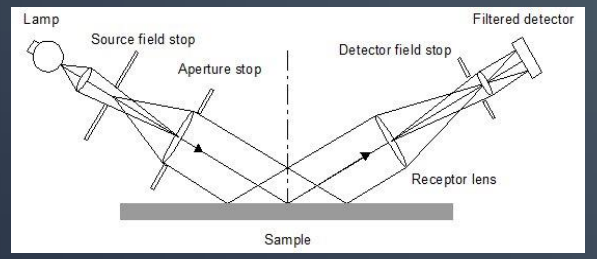
Advantages of plasma polishing process

- Automatic polishing process
- Uniform roughness and gloss
- High dimensional tolerance
- Dust explosion
- No toxic solution and waste

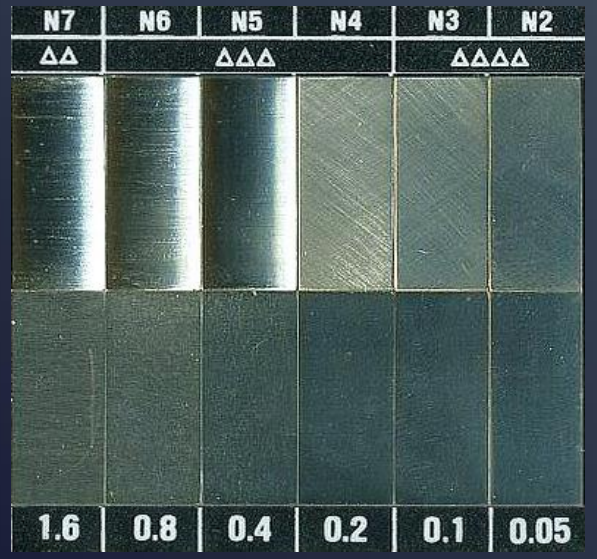


Material Characterization Method

- Glossmeter
  - Gloss is an optical property which indicates how well a surface reflects light in a specular (mirror-like, >600 GU) direction.

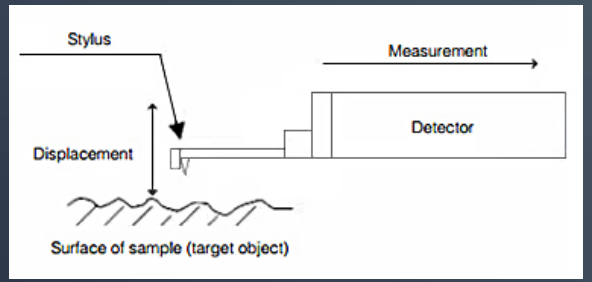


- Morphology
  - The morphology of a surface is characterized by an optical microscope with a digital camera.



Material Characterization Method

- Roughness meter
  - Roughness is the average of vertical deviations from nominal surface over a specified length surface.



Stylus Profilometer

Optical Profilometer

Plasma polishing of stainless steel (SS)

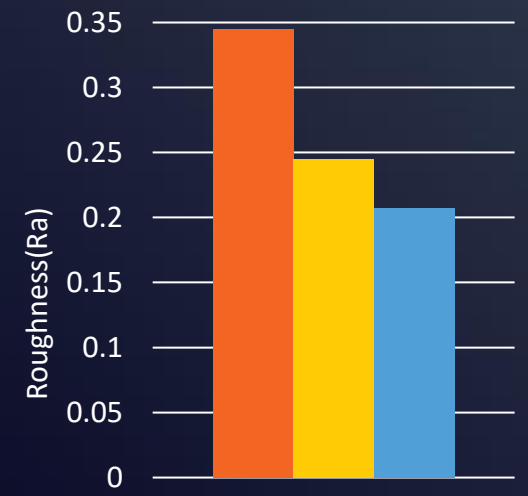
Watch bracelet

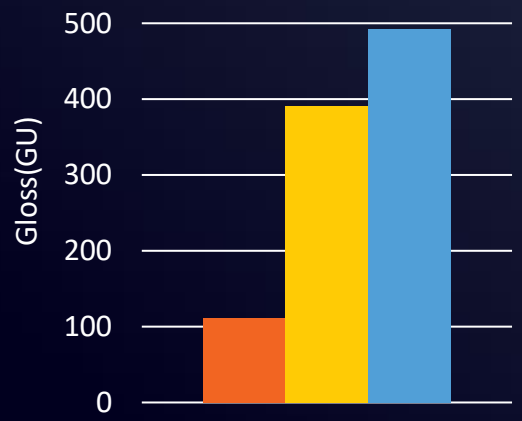
Watch case

Watch clasp

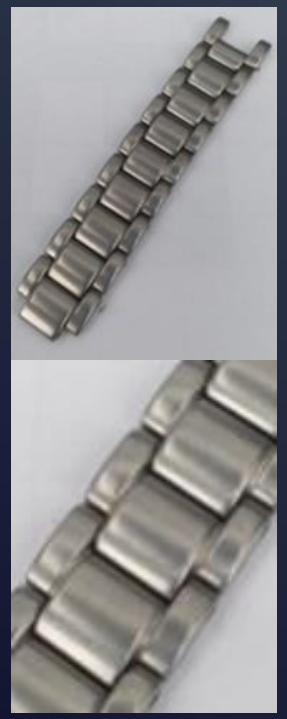
Glasses

Plasma polishing results of watch bracelet (SS)

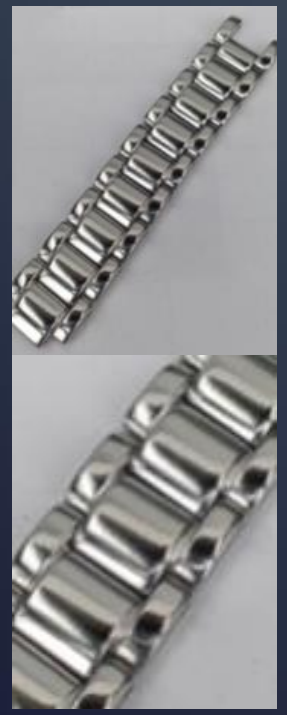




Unpolished ■ Rough polishing ■ Fine polishing

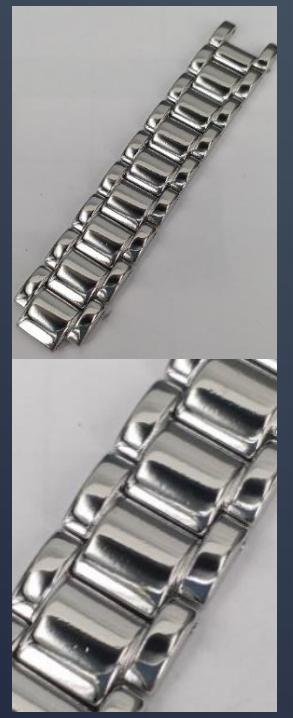


Unpolished



Rough polishing

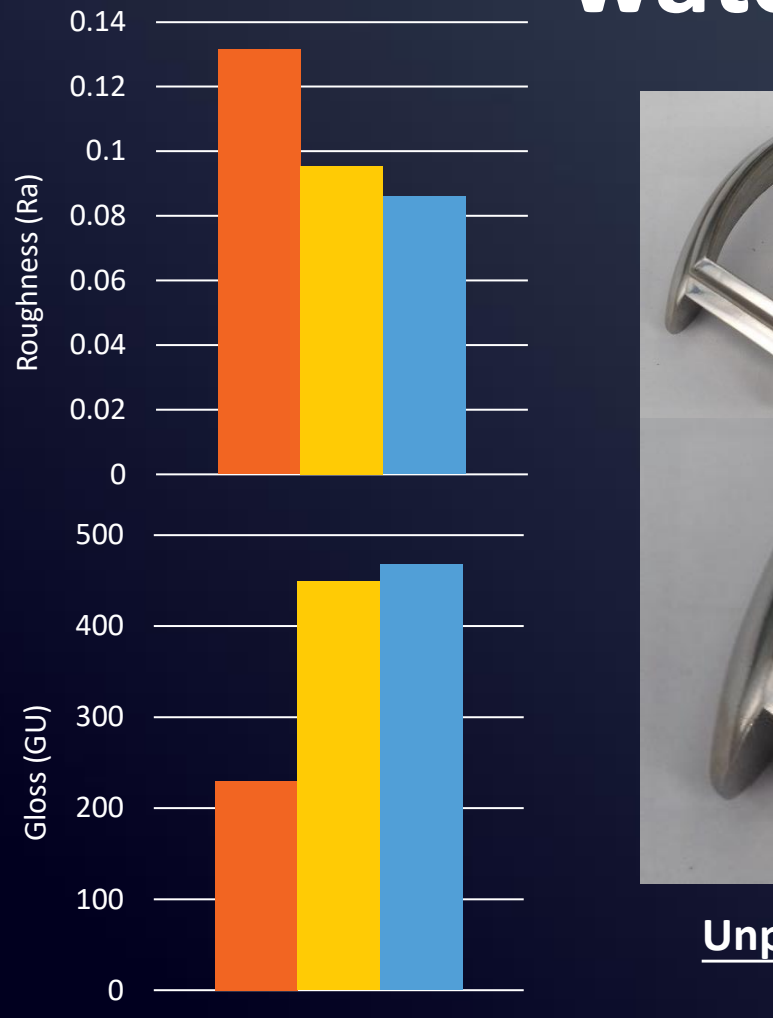
300 V
60°C
3 min



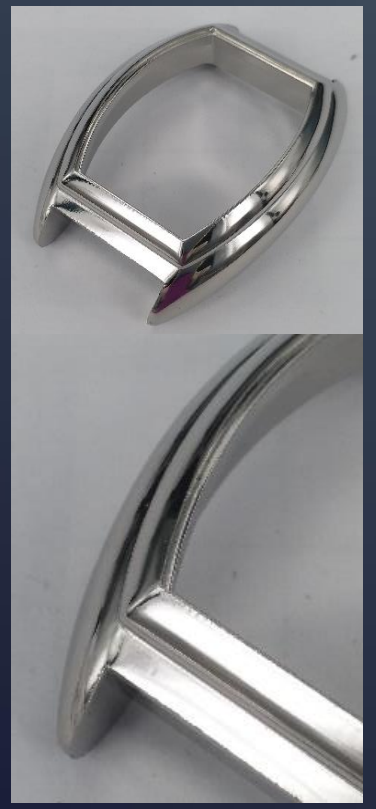
Fine polishing

300 V
60°C
3 min

Plasma polishing results of watch case (SS)



Unpolished



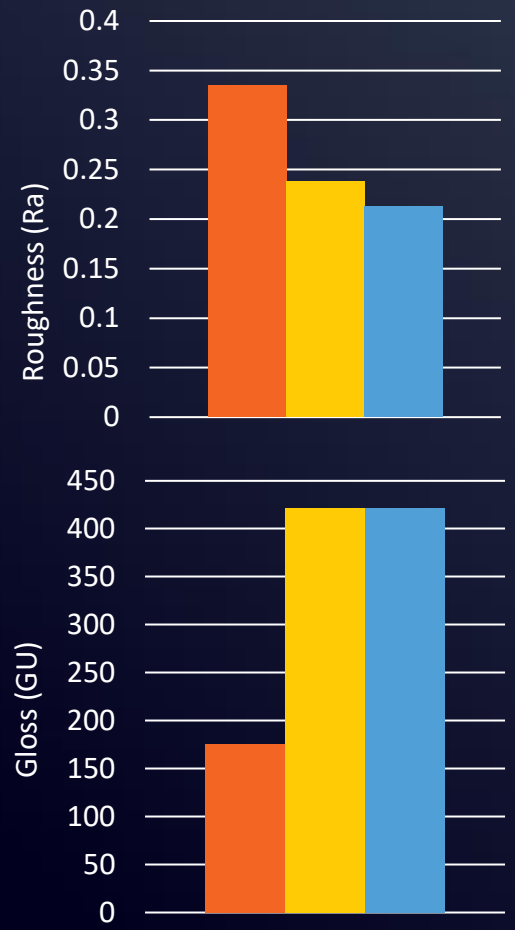
Rough polishing

300 V
60℃
3 min

Fine polishing

400 V
80℃
3 min

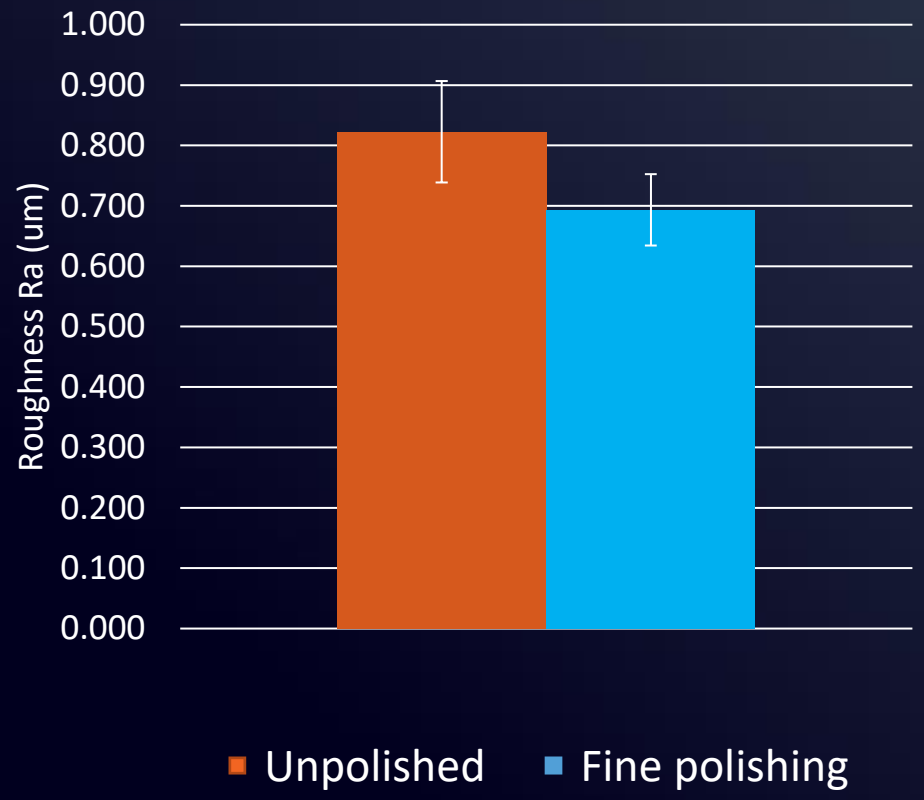
Plasma polishing results of watch clasp (SS)



Unpolished	Rough polishing	Fine polishing
	300 V 60℃ 3 min	300 V 80℃ 3 min

Plasma polishing results of glasses (SS)

Polishing condition: 300 V 80℃ 2 min

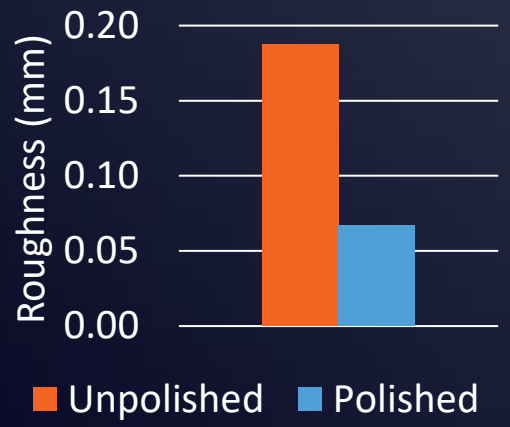


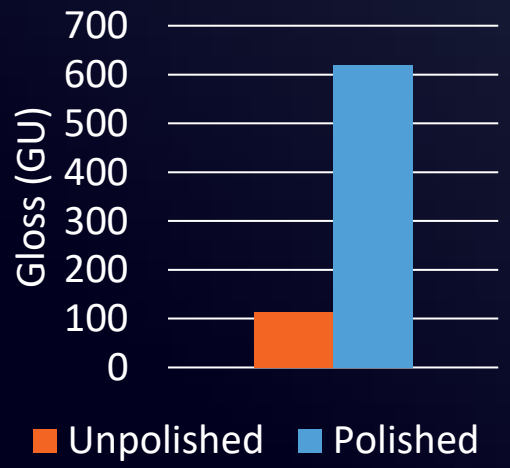
Unpolished

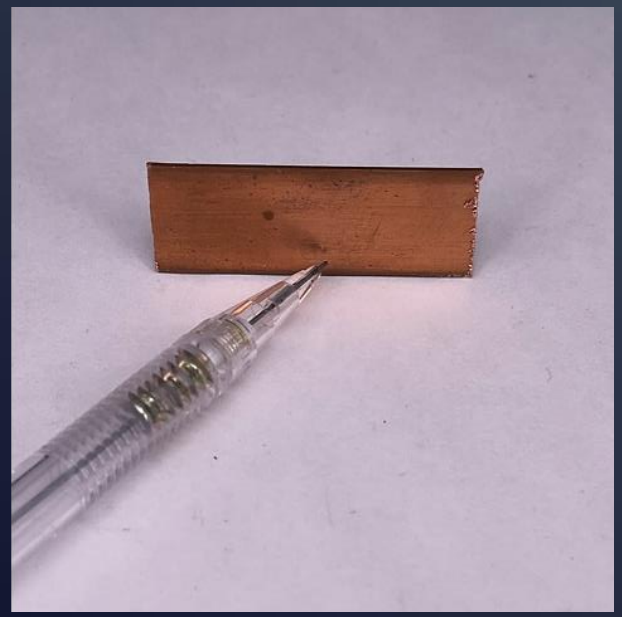
Fine polishing

Plasma polishing of Copper sample

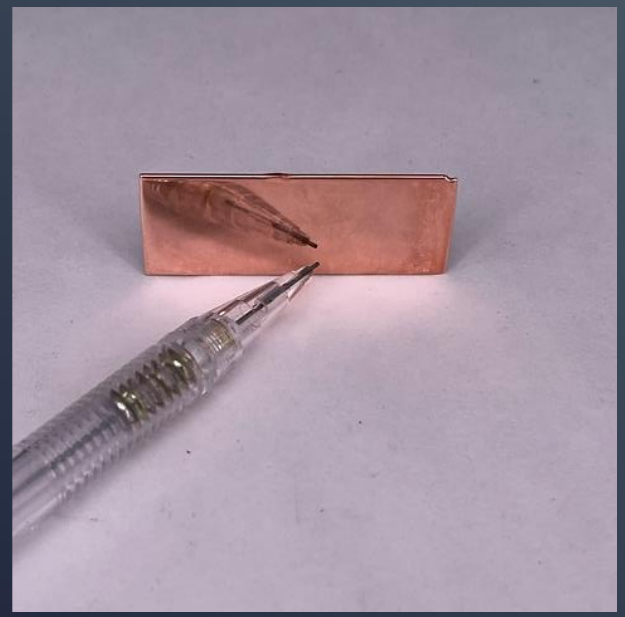
Polishing condition: 300 V 80℃ 3 min







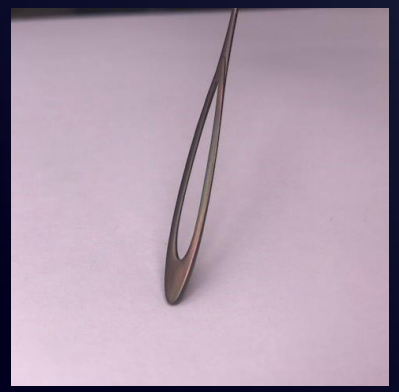
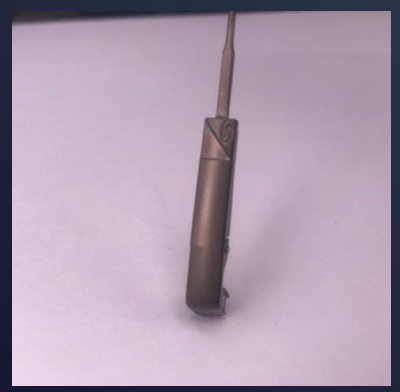
Unpolished



Polished

Plasma polishing of Titanium (Ti)

Polishing condition: 550 V 85℃ 1 min

	β-Ti		Pure Ti	
Unpolished				
Fine polishing				

Summary

	Traditional polishing process	Plasma polishing process
Polishing time	> 10 minutes	1-6 minutes
Simple process	No	Yes
Labor-intensive	Yes	No
Removal of material	More	Less
Post-treatment of polishing solution	Yes	No
Environmental-friendly	No	Yes

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Q&A

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