

Simultaneous Surface Finishing of Biopsy Needles using Magnetic Abrasive Finishing

ABSTRACT

The surface finishing of the capillary tubes is necessary in finding an alternative method to make the biopsy needles which are used to detect breast cancer. It is essential for the needle to be polished for testing because otherwise, it may cause damage to removed tissue from the breast, and ultimately cause trauma. To reduce these issues Magnetic Abrasive Finishing (MAF) has been studied. This research clarifies the magnetic field distribution specifically required to achieve the simultaneous surface finishing of 18-gage 316 stainless steel needles, and the efficacy of the resulting simultaneous surface finishing is described.

MAGNETIC ABRASIVE FINISHING

The magnetic field is created by the permanent magnets attached to the steel yoke. The mixed magnetic abrasive inserted into the workpiece and pushed upon the inner surface of the tube through the magnetic force. At the outside of the magnetic abrasive are placed between the side of the pole tip and the workpiece. The magnetic abrasive shows smooth relative motion against the inner and outer surface when the tube is rotated at high speeds.

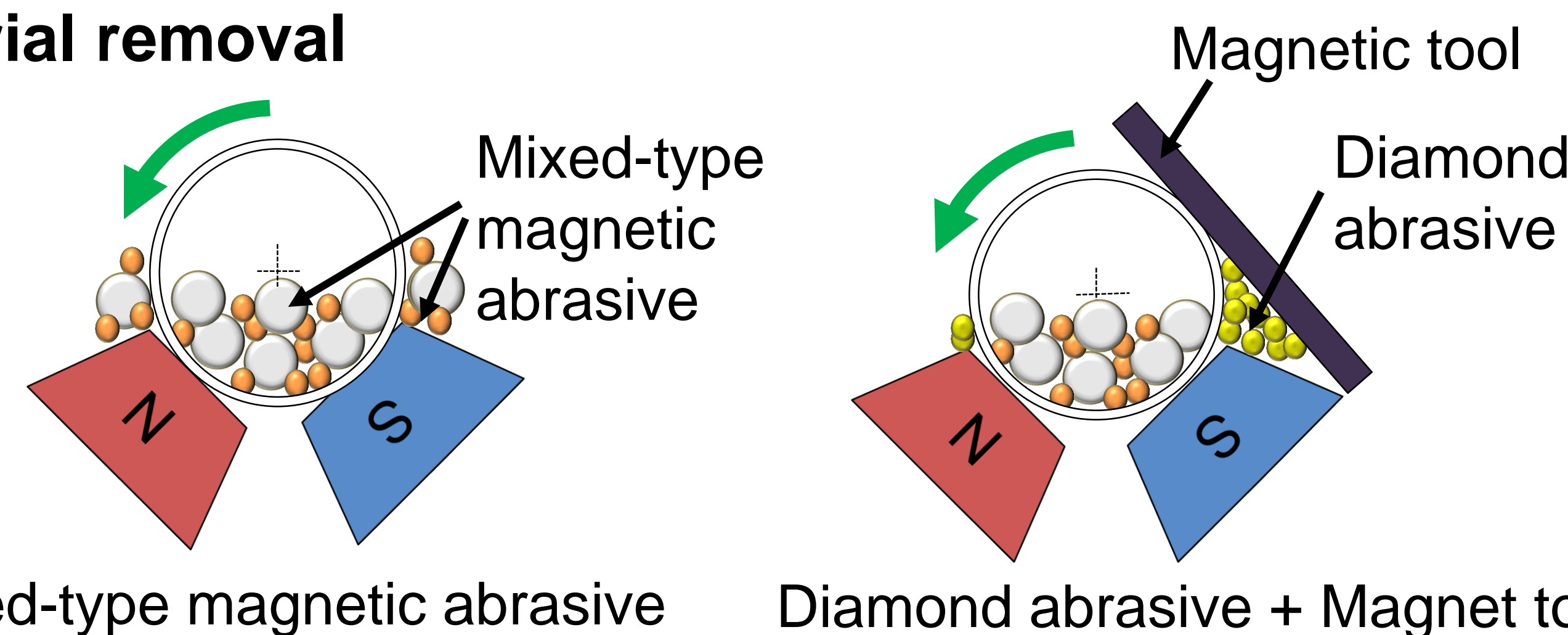
FINISHING CONDITIONS

Finishing target	Inside		Outside			
	mg	mg	mg	mg	mg	
Mixed-type magnetic abrasive*	11.4	0	5.57	14.25	22.8	-
Diamond abrasive	-	-	-	-	-	4-8 μm dia
Rubber magnet tool	-	-	-	-	-	28×14×4 mm
Workpiece	18 gauge 316 stainless steel tube (∅ 1.27×∅1.14×100 mm)					
Workpiece revolution	10000 min ⁻¹					
Magnet	Nd-Fe-B magnet: 12.7×12.7×12.7 mm					
Tape around pole tips	0.13 mm thick PTFE tape					
Pole-tip feed	Length: 12.7 mm, Feed rate: 0.59 mm/s					
Finished length	25.4 mm					
Lubricant	Soluble-type barrel finishing compound					
Finishing time	5 min					

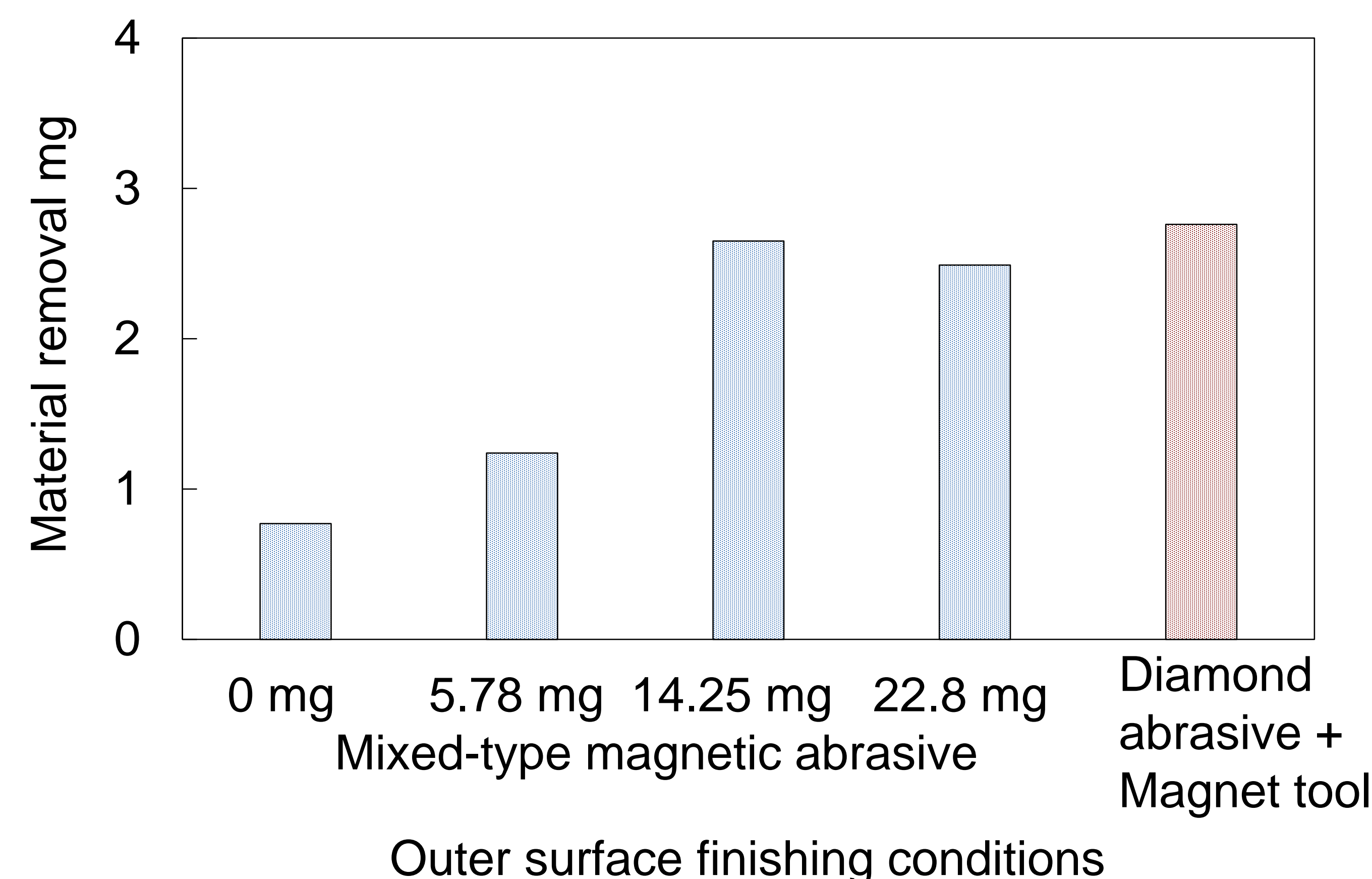
* Iron particles (150-300 μm dia.): 80 wt%, Aluminium oxide magnetic abrasive (80 μm mean dia.): 20 wt%

FINISHING CHARACTERISTICS

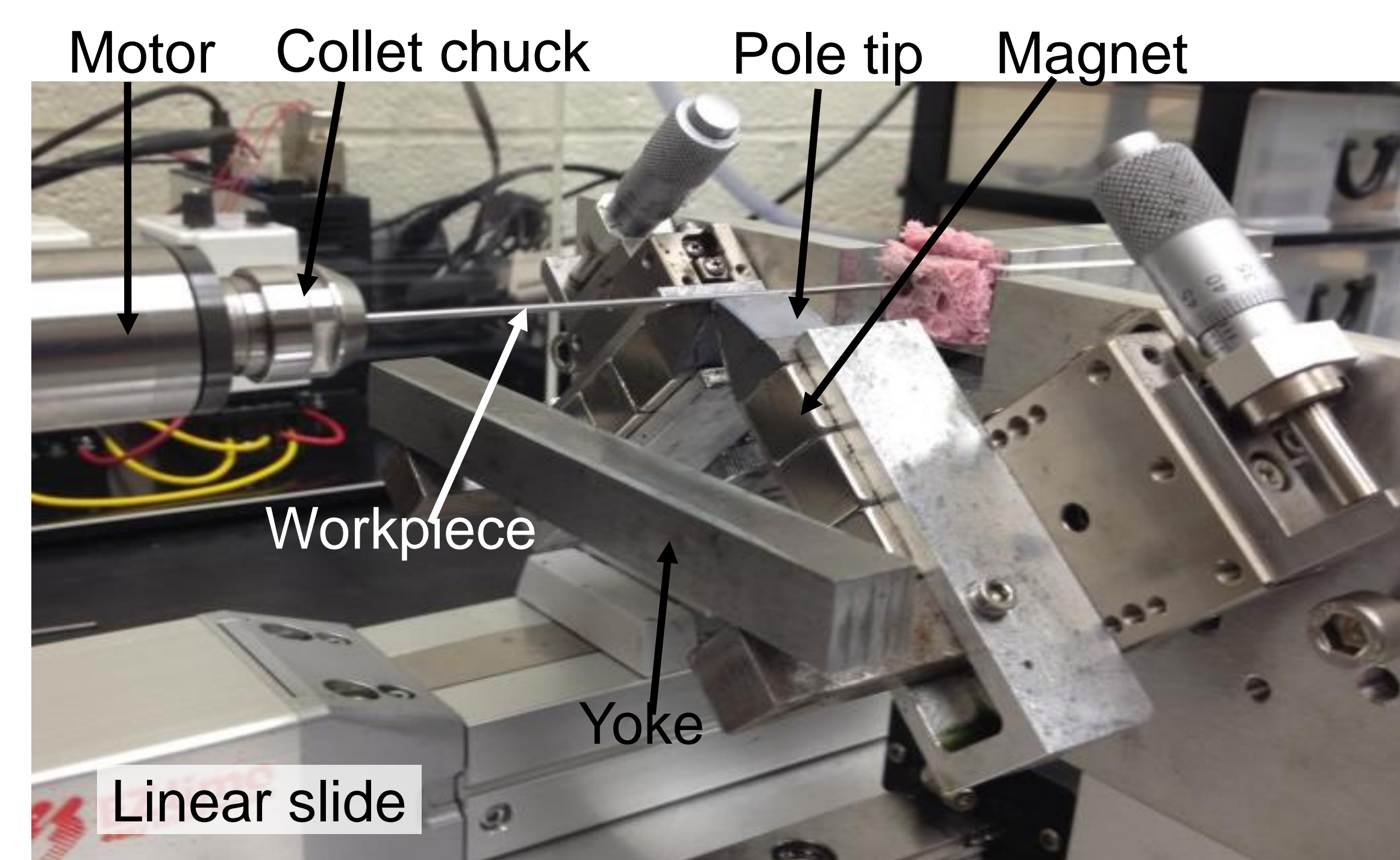
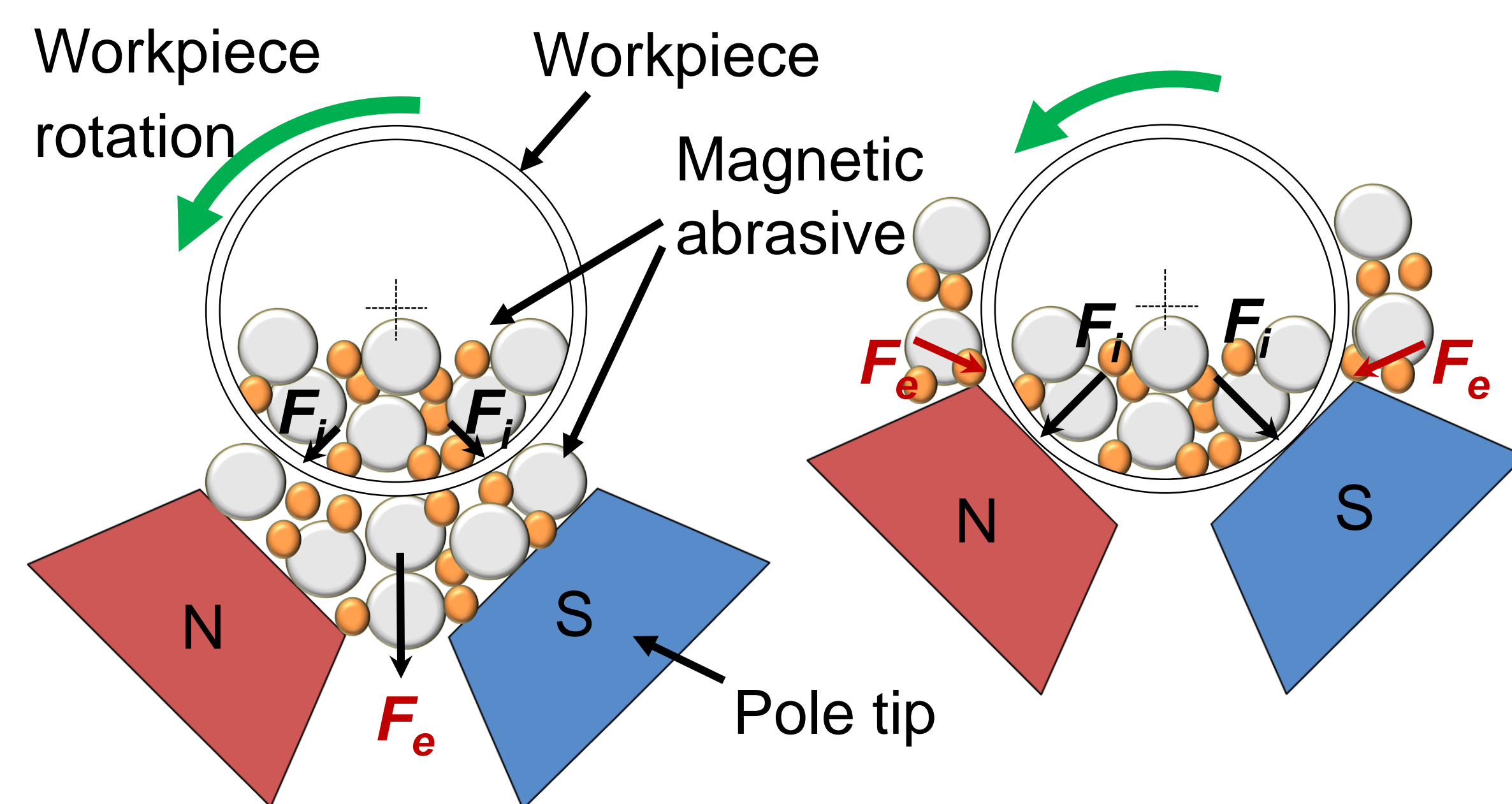
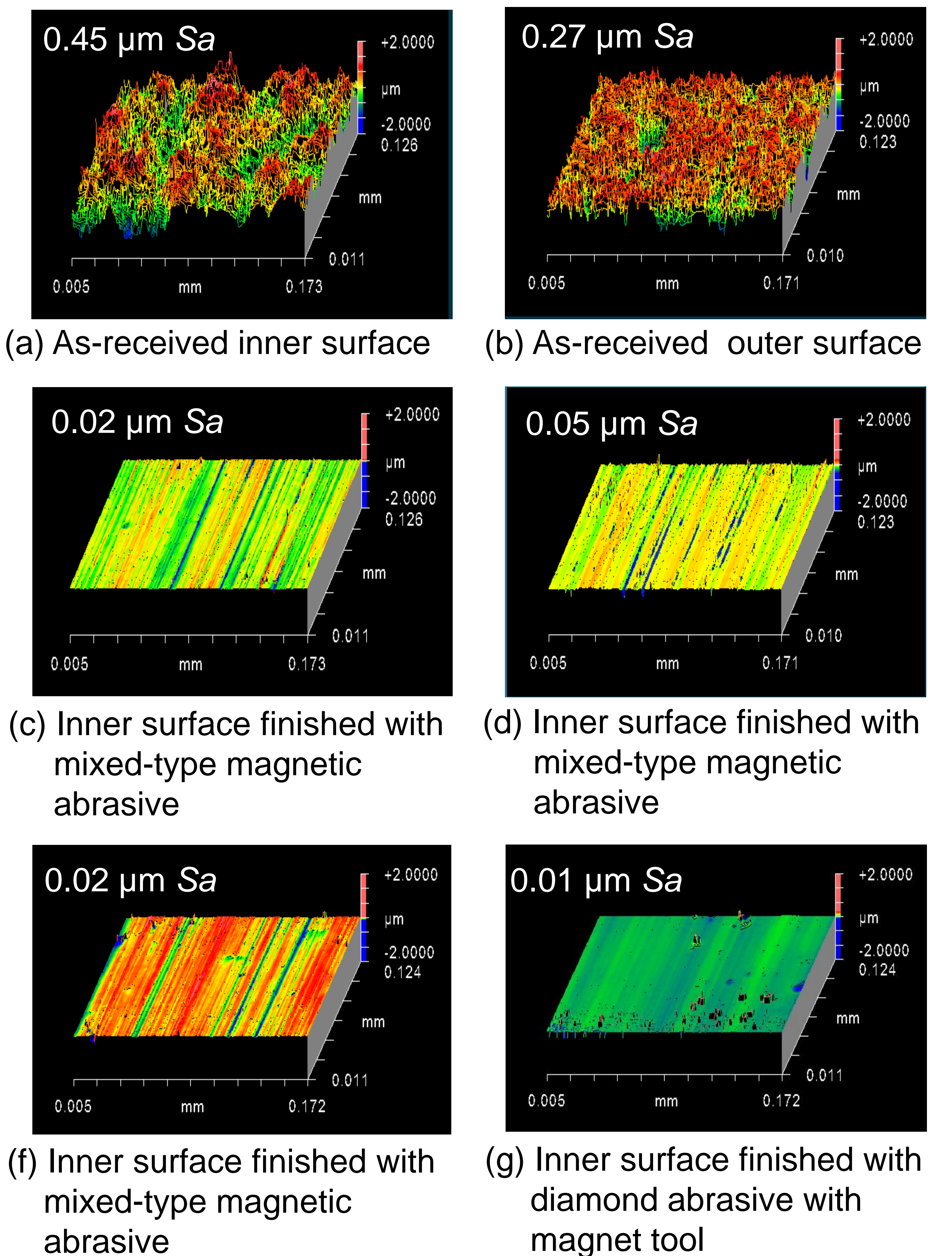
Material removal



Mixed-type magnetic abrasive Diamond abrasive + Magnet tool



Surface profiles captured by optical profiler



Photograph of experimental setup 20 mm

CONCLUSIONS

1. High-performance finishing is possible using magnetic abrasive for internal finishing and a magnet tool with abrasive slurry for external finishing.
2. Time needed for finishing : 40 min to 5 min
Surface roughness: From 0.4 – 0.5 μm Sa to 0.01 μm Sa

ACKNOWLEDGEMENTS

This work was supported by National Science Foundation Grant No. CMMI-1266179