

Objective

The aim of this in vitro study was to compare flexural strength, surface roughness, and biofilm formation of ceramic-reinforced PEEK in comparison with conventionally fabricated and CAD-CAM denture base materials.

Methods

Thirty strips (6.4×10×3 mm) and 39 discs (10×1 mm) were fabricated from a heat-compressed polymethyl methacrylate (HP-PMMA), milled PMMA (M-PMMA), and ceramic-reinforced PEEK (CR-PEEK), 10 each. One surface of each sample was polished to mimic the clinical procedure. Strips were then subjected to a 3-point bend test using a universal testing machine at a crosshead speed of 5.0 mm/min. A non-contact optical profilometer measured the surface roughness of discs at polished and unpolished sides. Biofilm formation behavior was analyzed through Candida albicans adhesion to the unpolished surface of discs. One-way ANOVA followed by Tukey multiple comparison tests were used to compare the flexural strength, surface roughness, and biofilm formation of studied materials ($\alpha=0.05$).

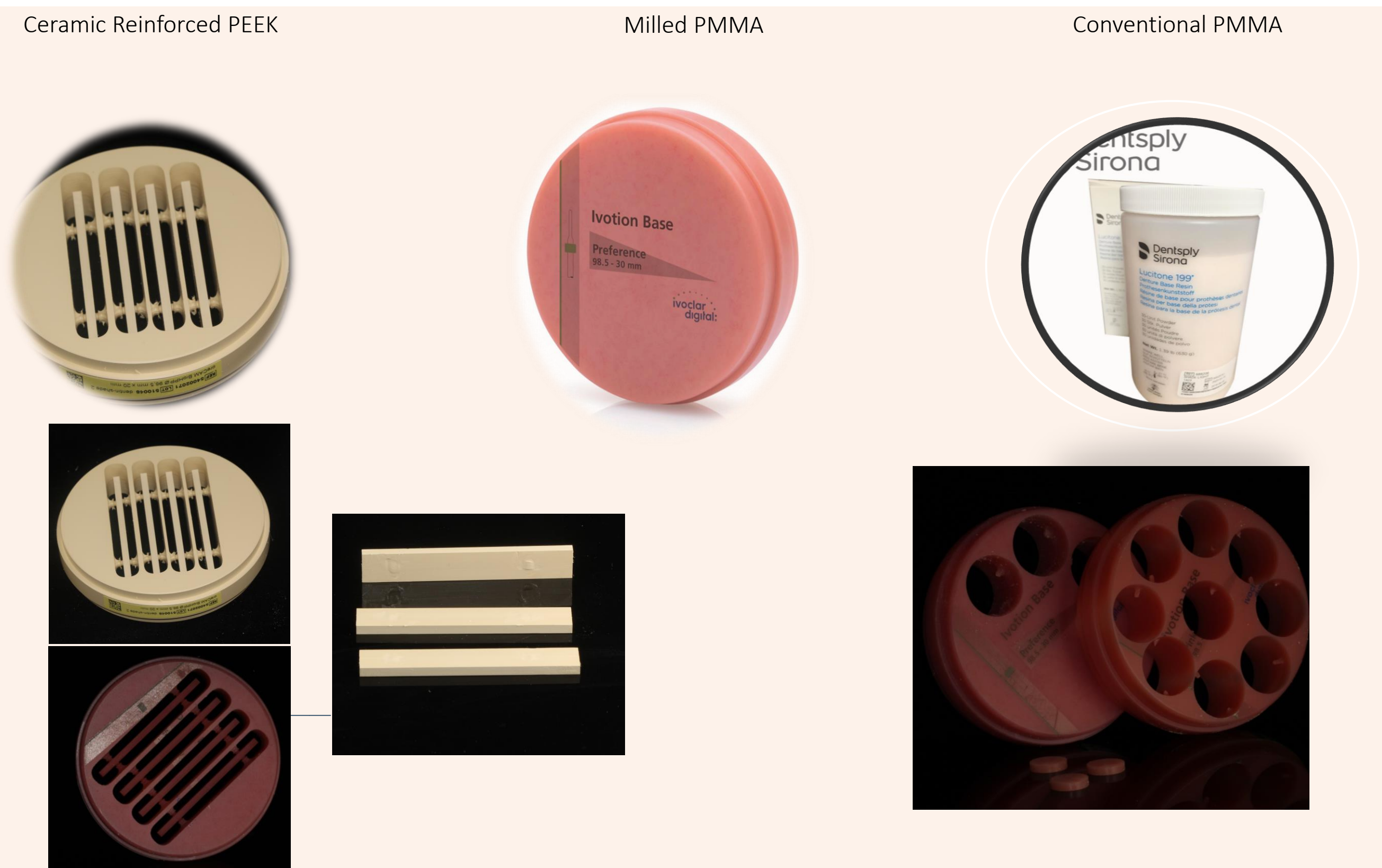


Figure 1. Tested materials

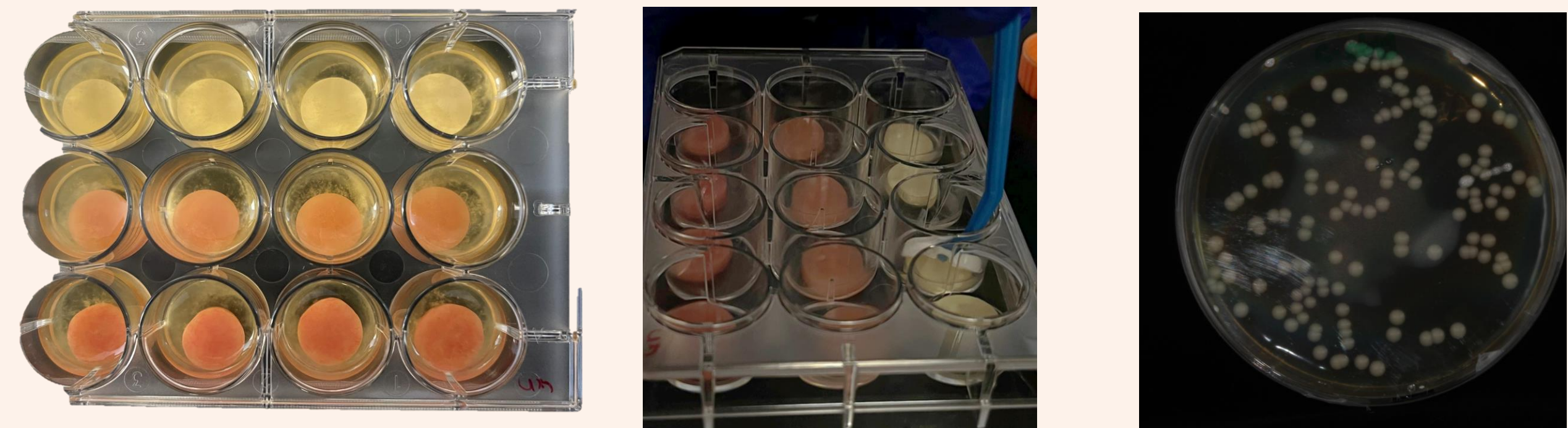


Figure 2: CFU counting YPD plate.

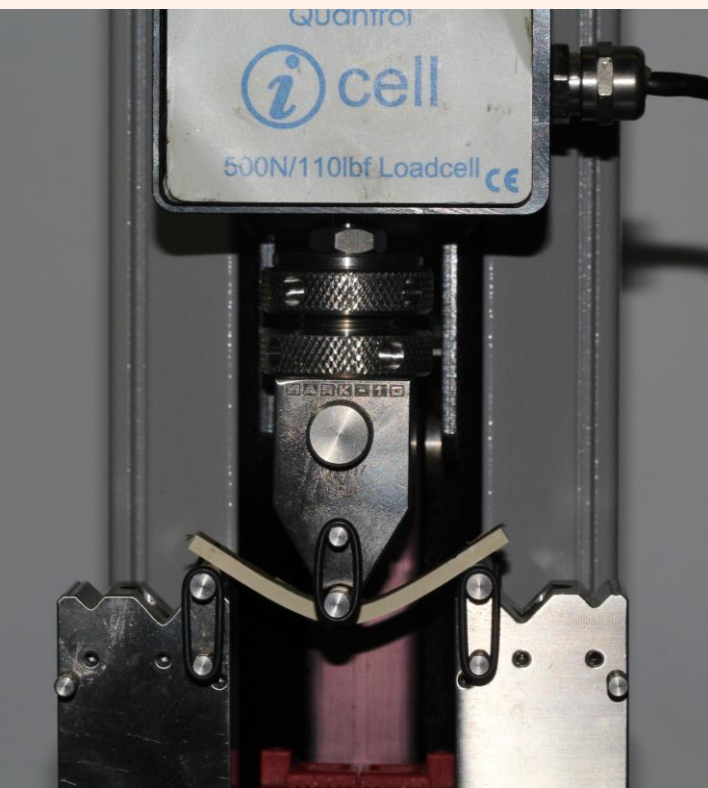


Figure 3. 3-point bend test universal machine

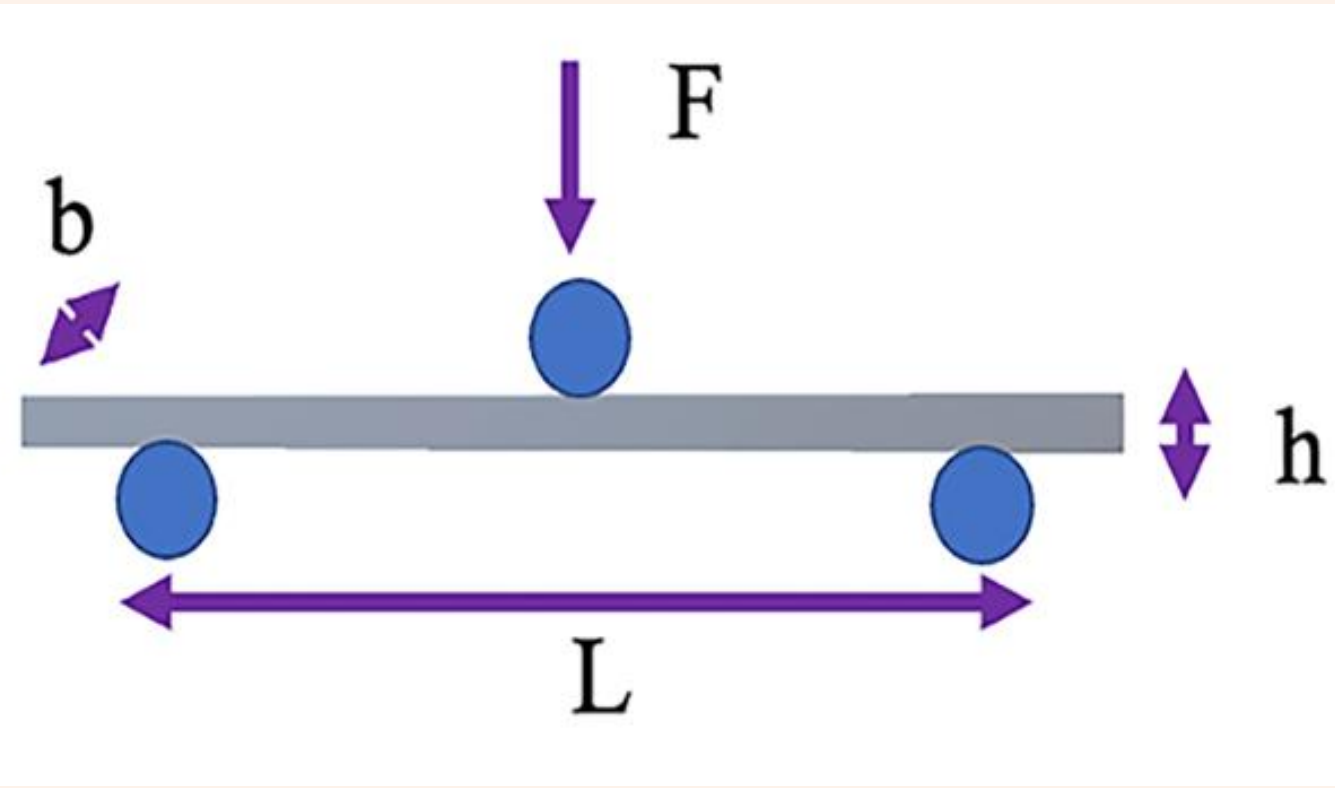
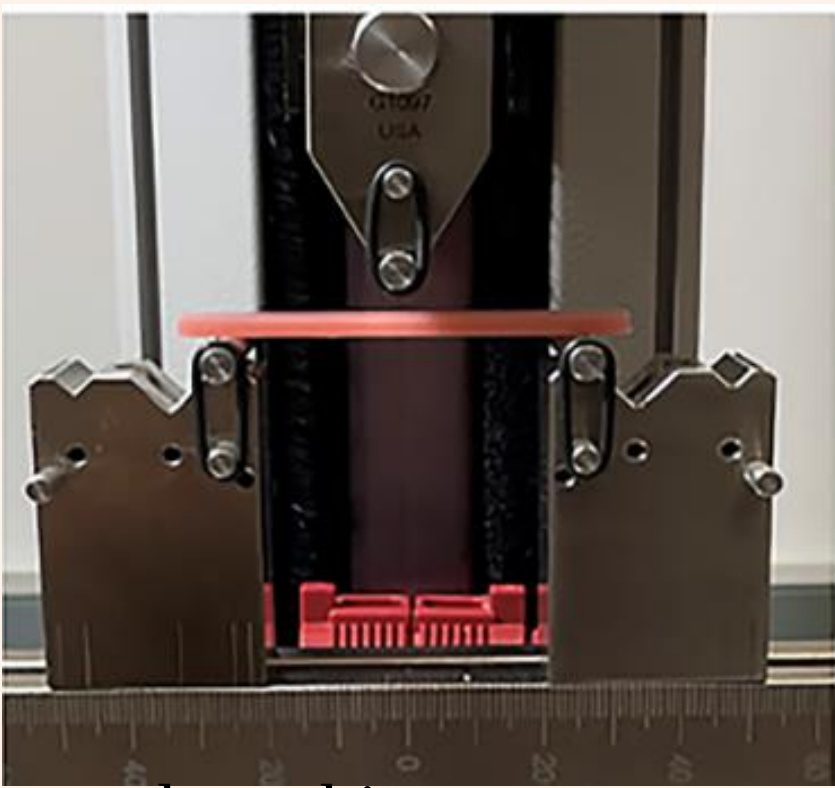


Figure 4. SEM analysis machine

Results

CR-PEEK showed significantly higher flexural strength (178.2 ± 3.2 MPa) than M-PMMA (89.6 ± 0.8 MPa; $p<0.001$) and HP-PMMA (67.3 ± 5.3 MPa; $p<0.001$). CR-PEEK showed a significantly ($P<0.05$) higher Ra value than the other groups for polished and unpolished sides; however, the polishing process significantly ($p<0.05$) reduced the Ra value of the studied groups. There was no significant ($P<0.05$) difference in Candida albicans adhesion among groups.

	Unpolished			Polished		
Material	HP-PMMA	CR-PEEK	M-PMMA	HP-PMMA	CR-PEEK	M-PMMA
Mean $\pm$ SD	1.29 ± 0.72^A	6.46 ± 0.98^B	2.46 ± 0.14^A	0.12 ± 0.01^C	0.32 ± 0.04^C	0.13 ± 0.01^C

Table 1. Ra value (μm) of tested materials before and after polishing.

The same superscript letter in the right column indicates no significant difference ($p<0.05$).

HP-PMMA= Lucitone 199; M-PMMA= IvoBase CAD; CR-PEEK= BioHPP

	HP-PMMA	CR-PEEK	M-PMMA
Mean $\pm$ SD	1.045 ± 0.09	1.045 ± 0.04	1.095 ± 0.14

Table 2. Mean of colony-forming unit (1×10^5)/ml after 48-hours of incubation.

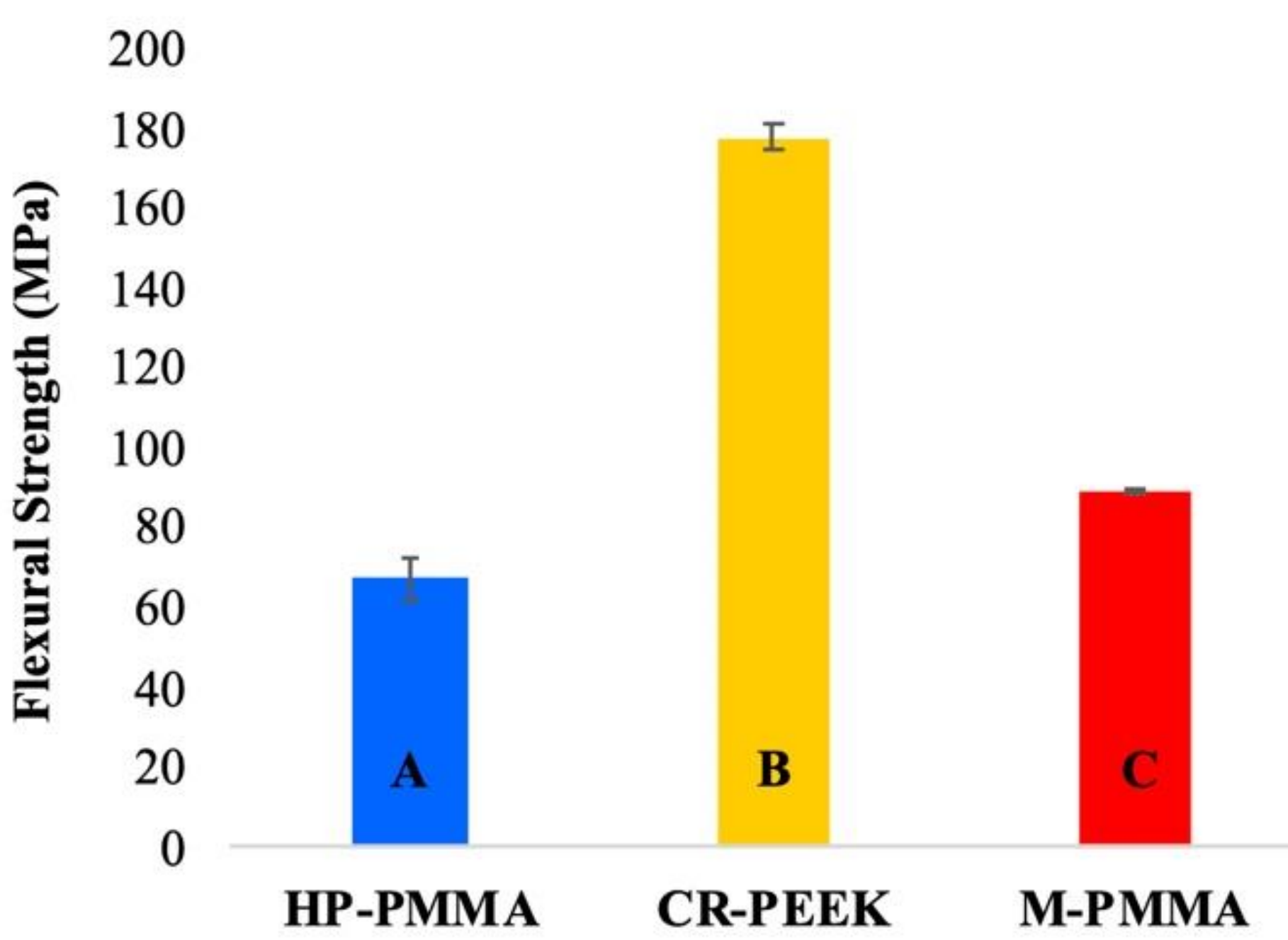


Figure 5. Flexural strength (MPa) of tested materials

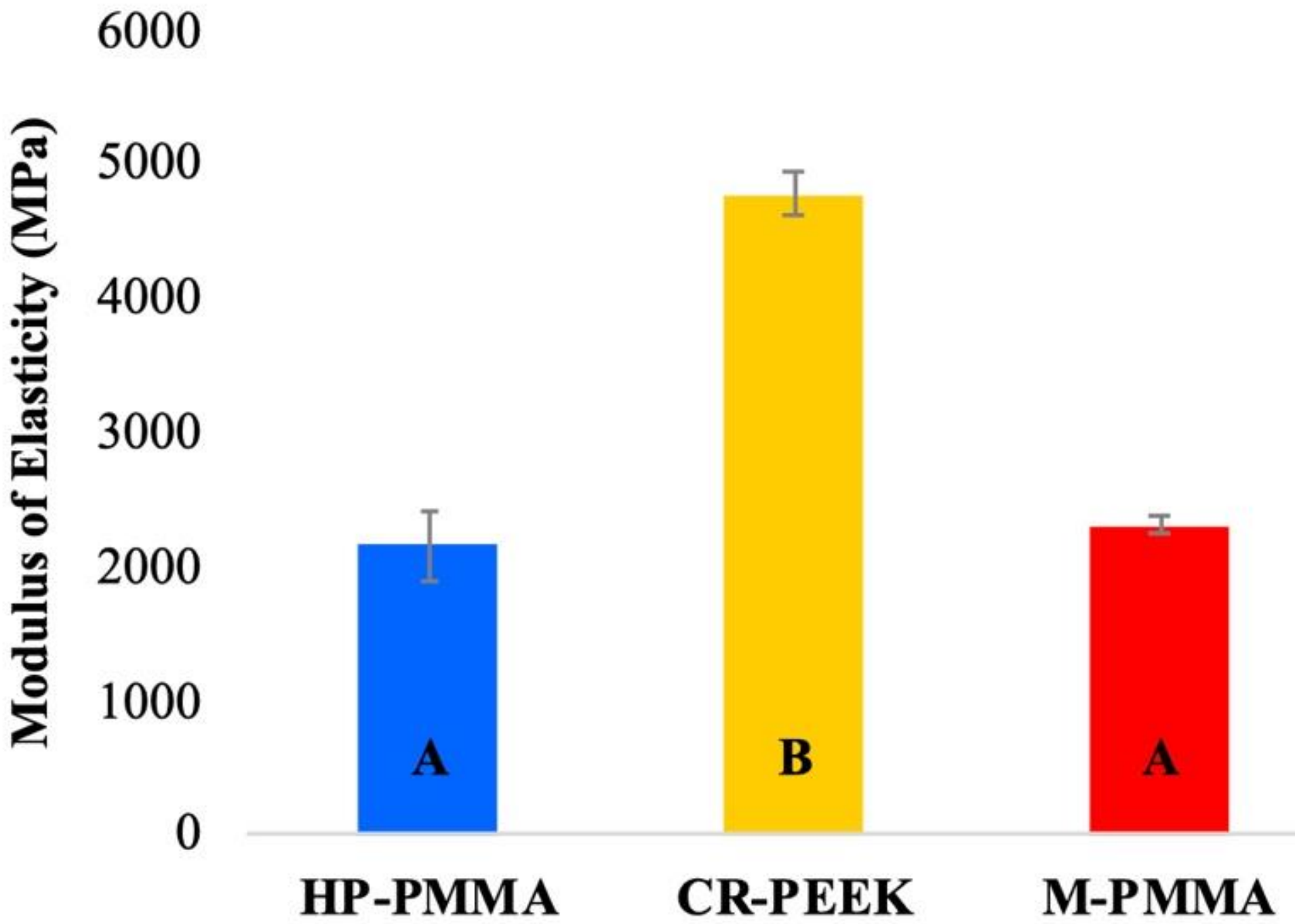


Figure 6. Modulus of elasticity (MPa) of tested materials

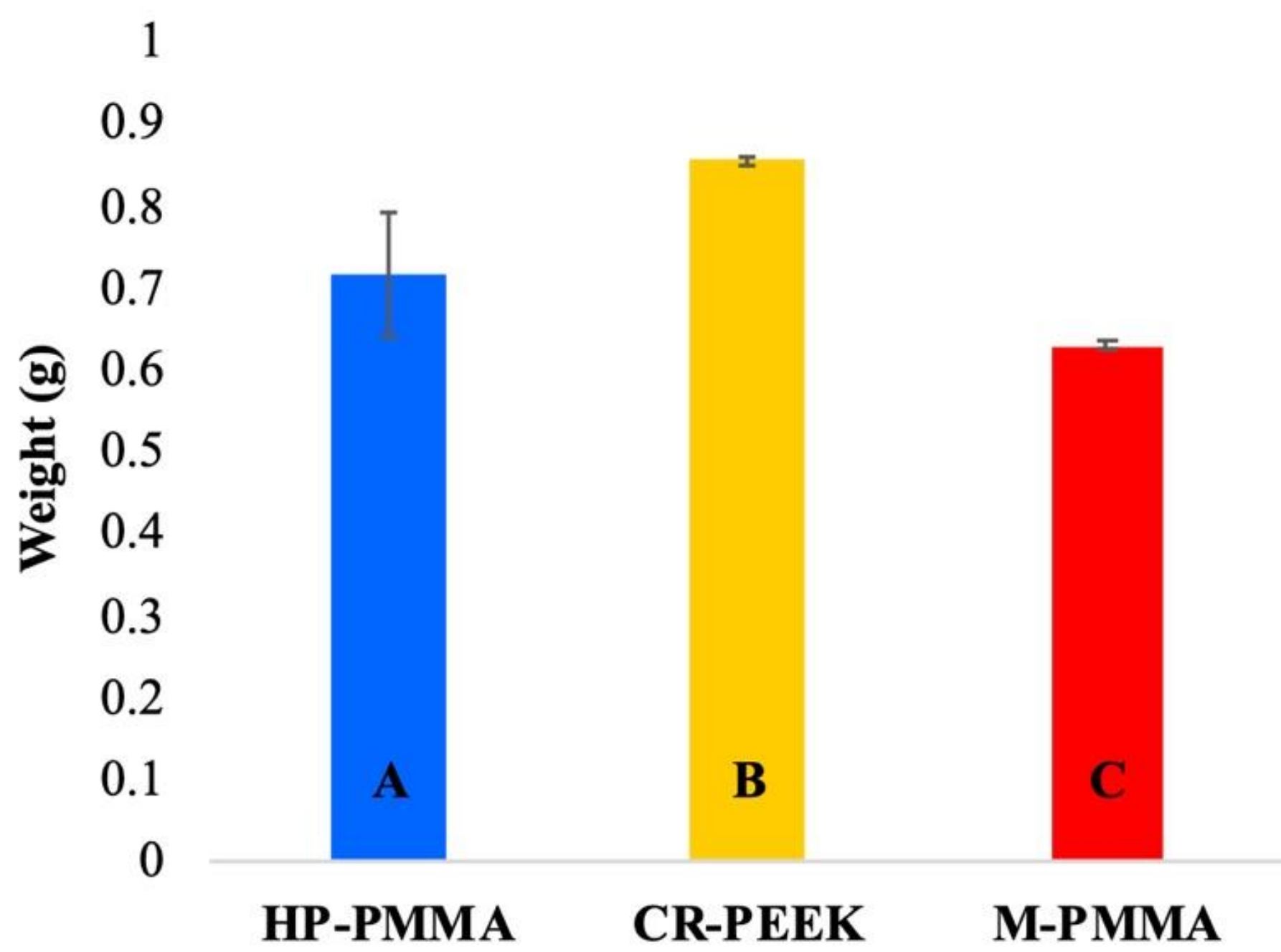


Figure 7. Weight (g) difference for tested material.

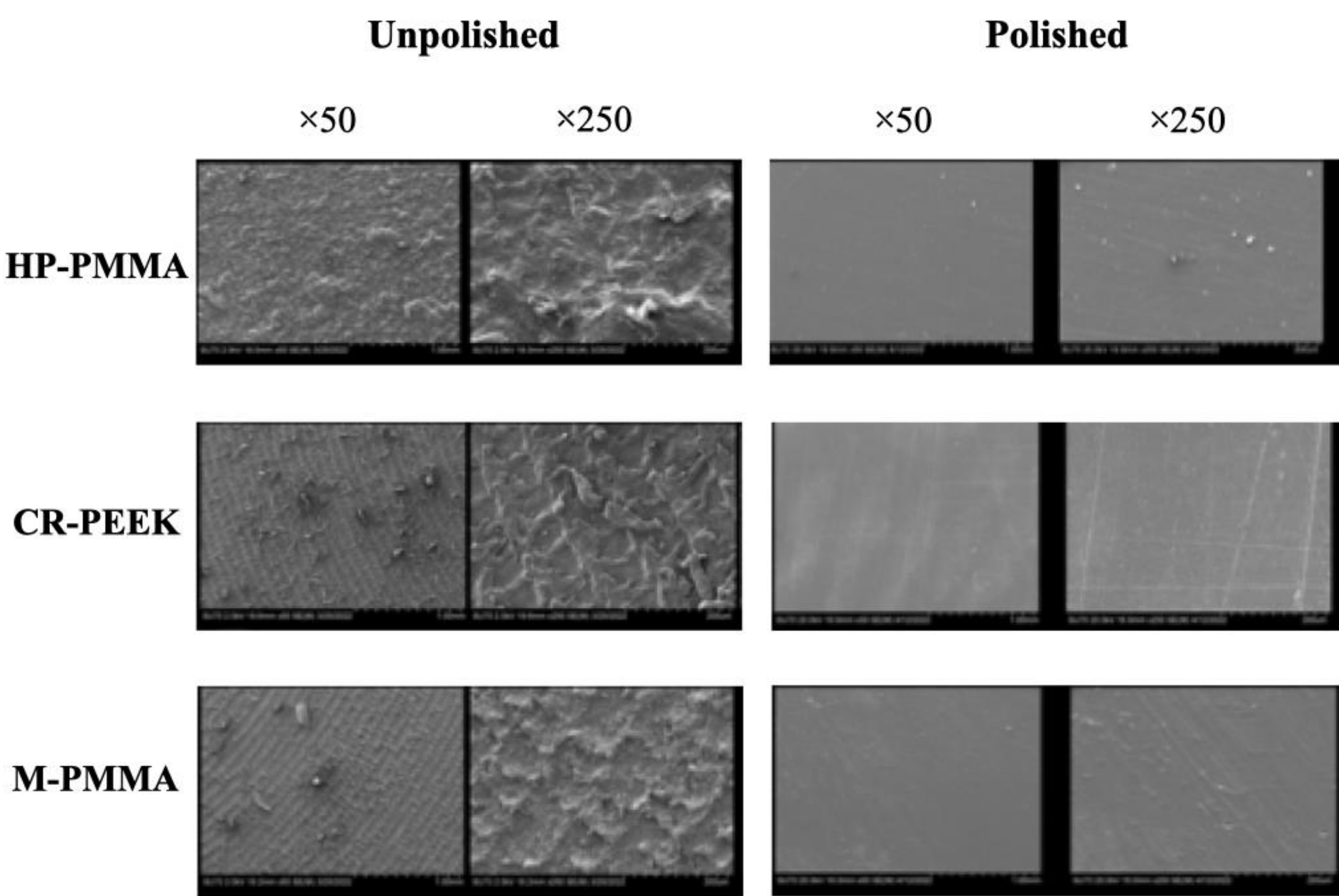


Figure 8. SEM analysis of unpolished and polished for each material at $\times 50$ and $\times 250$

Conclusion

The flexural strength of tested materials was within acceptable limits for clinical use as a denture base material. CR-PEEK had the highest surface roughness; however, its biofilm formation was similar to other clinically accepted denture base materials.

References

1. Stawarczyk B, Jordan P, Schmidlin PR, Roos M, Eichberger M, Gernet W, Keul C. PEEK surface treatment effects on tensile bond strength to veneering resins. J Prosthet Dent. 2014;112(5):1278-88.
2. Cakmak G, Donmez MB, Atalay S, de Paula MS, Fonseca M, Schimmel M. Surface roughness and stainability of CAD-CAM denture base materials after simulated brushing and coffee thermocycling. J Prosthet Dent. 2022;19:S0022-3913(22)00380-8.