Thermoplastic polymer blend as novel material for denture base

Faculty of Dentistry
Chulalongkorn University

Taksid Charasseangpaisarn[1,2], Chairat Wiwatwarrapan[2], Viritpon Srimaneepong[2]

Aim or purpose

To develop new polymer blend, the glass transition temperature (T_g), flexural properties including flexural strength and flexural modulus of thermoplastic polymer blend between poly(methyl methacrylate) and poly(lactic acid) (PMMA/PLA blend) were investigated and compared to currently available denture base materials.

Materials and methods

Thermoplastic injection polyamide (VP), fuse-deposition modelling PLA (FL), heat-polymerized compression molding PMMA (CM), and thermoplastic injection PMMA/PLA blend (PB) were 4 kinds of polymers investigated in this study.

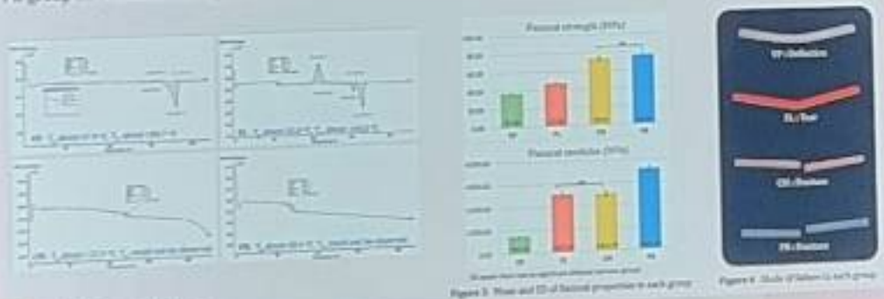
The T_g of each material was investigated with differential scanning calorimetry (DSC). The eight bar-shaped specimen size 65x10x3.3 mm of each group were fabricated with the proper condition of each material.

The specimens were polished and immersed in 37°C water for 48 hours prior to flexural testing by universal testing machine. The testing conditions complied with ISO 20795-1.

The data of flexural strength and flexural modulus was collected and analyzed by one-way ANOVA with post-hoc test.

Results

The CM group showed the highest T_g followed by PB, FL, and VP groups, accordingly. The flexural strength of PB group was the highest but not was significantly different from CM group, while VP group showed the lowest flexural strength. The PB group also showed the highest flexural modulus than the others while VP group showed the lowest flexural modulus.



Conclusion

By blending PMMA with PLA, T_g of this polymer blend could be increased to the suitable level for intra-oral usage. Because it has the comparable flexural strength, and higher flexural modulus than that of conventional heat-polymerized PMMA, thermoplastic injection PMMA/PLA blend could be alternative material for denture base.

Acknowledgement

This study was funded by 90th Anniversary of Chulalongkorn University Fund, Graduated School of Chulalongkorn University and Dental Biomaterials Science Curriculum.

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Table 1 Details of each product using in the study

Group	Composition	Product	Manufacturer
VP	Polyamide	Valplast®	Valplast International Corp, USA
FL	Poly(lactic acid)	eSUN®	Shenzhen Esun Industrial Co. Ltd., China
CM	Poly(methyl methacrylate)	Meliodent	Kulzer GmbH, Germany
PB	PMMA/PLA blend	ACRYPET ™ and Ingeo™	Mitsubishi Chemical Corp, Japan NatureWorks LLC, USA

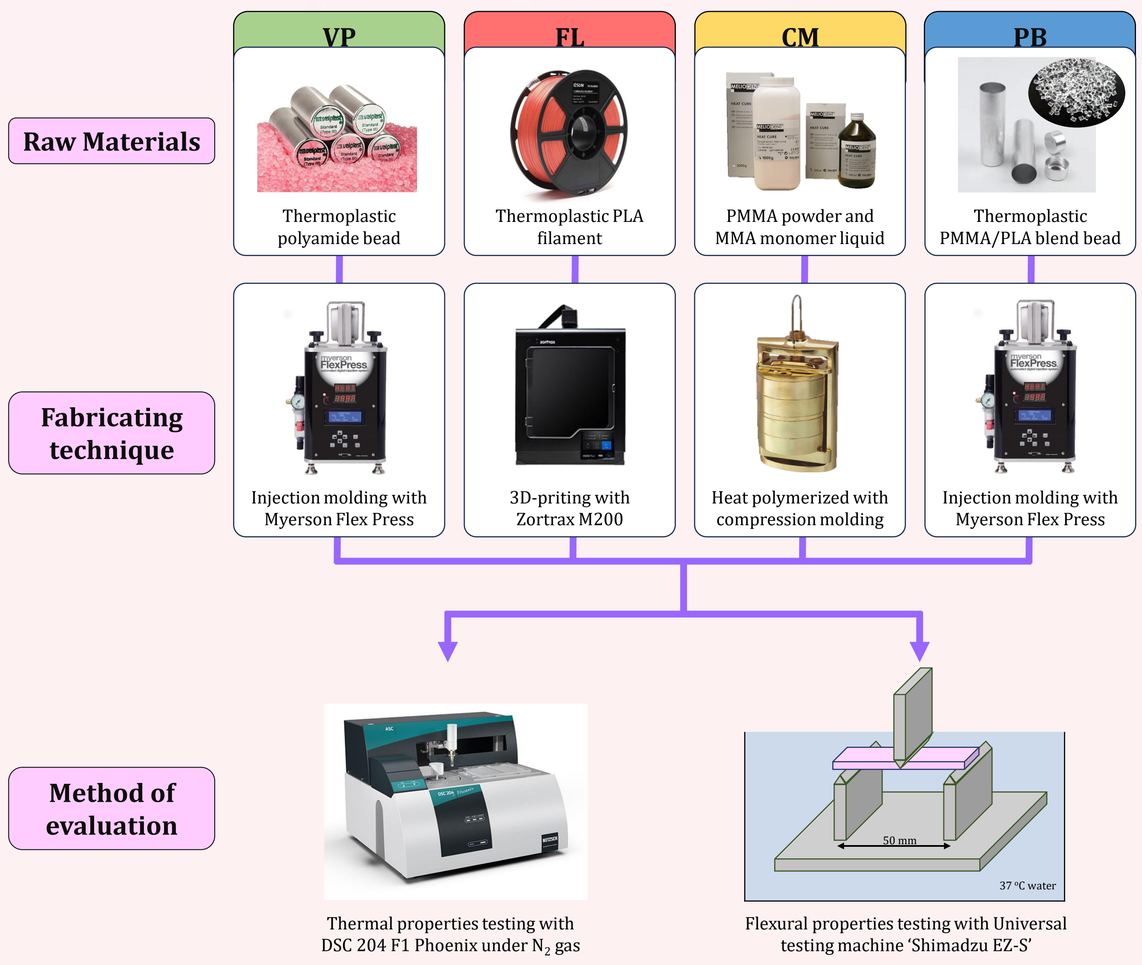

Figure 1 Raw materials, fabricating technique and method of evaluation in this study

Results

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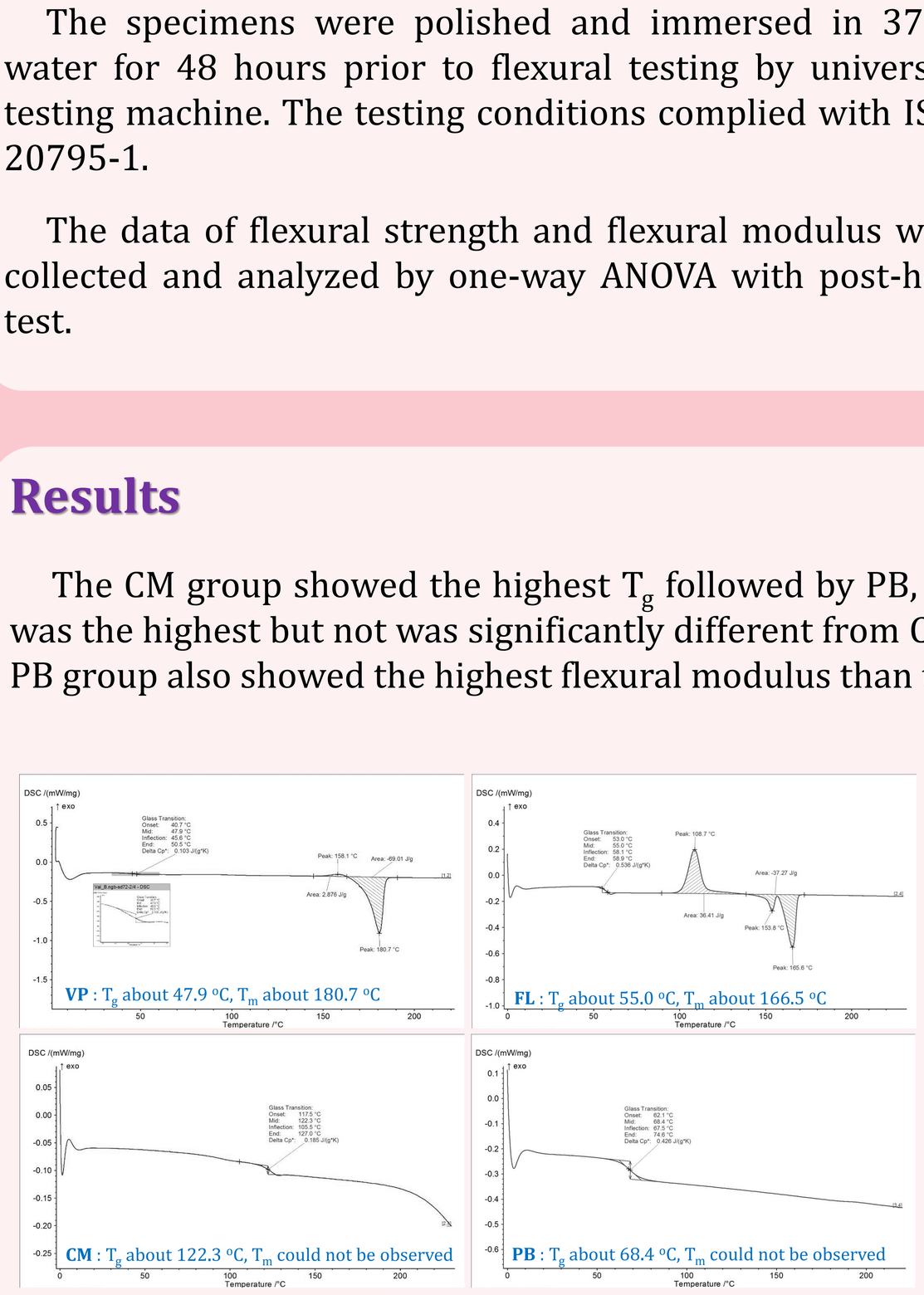
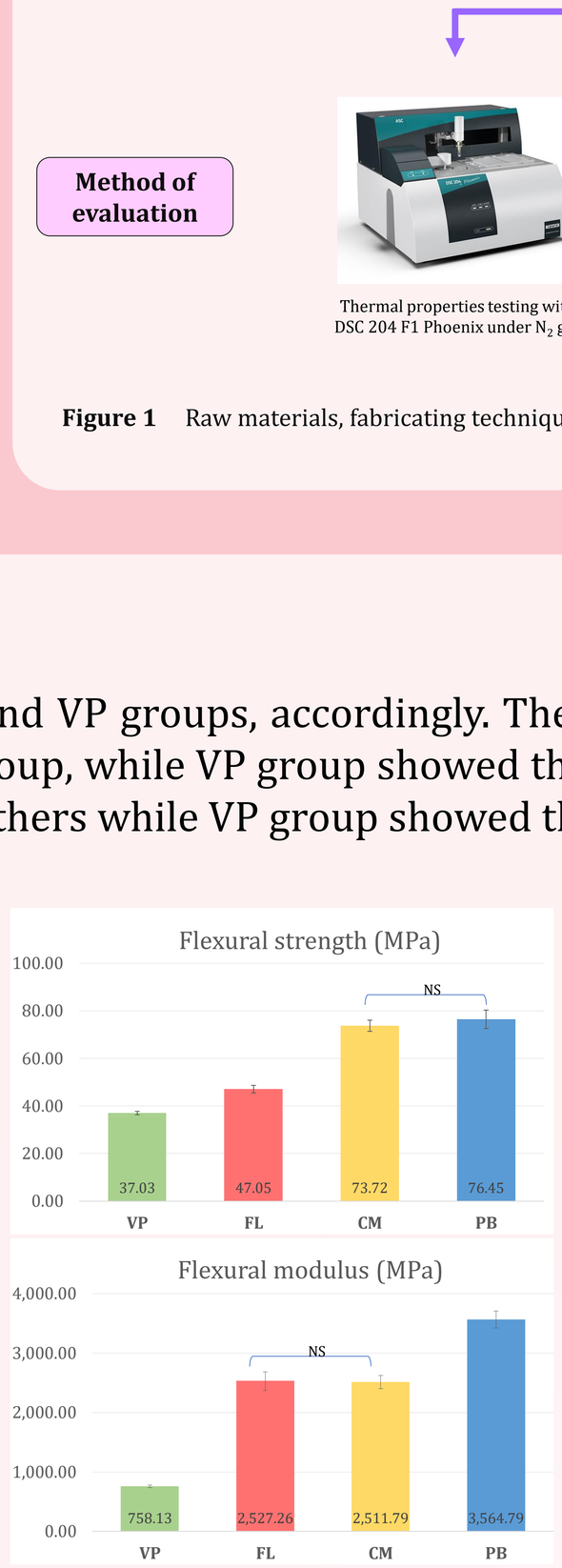


Figure 2 DSC thermogram of each group



NS meant there was no significant different between groups

Figure 3 Mean and SD of flexural properties in each group

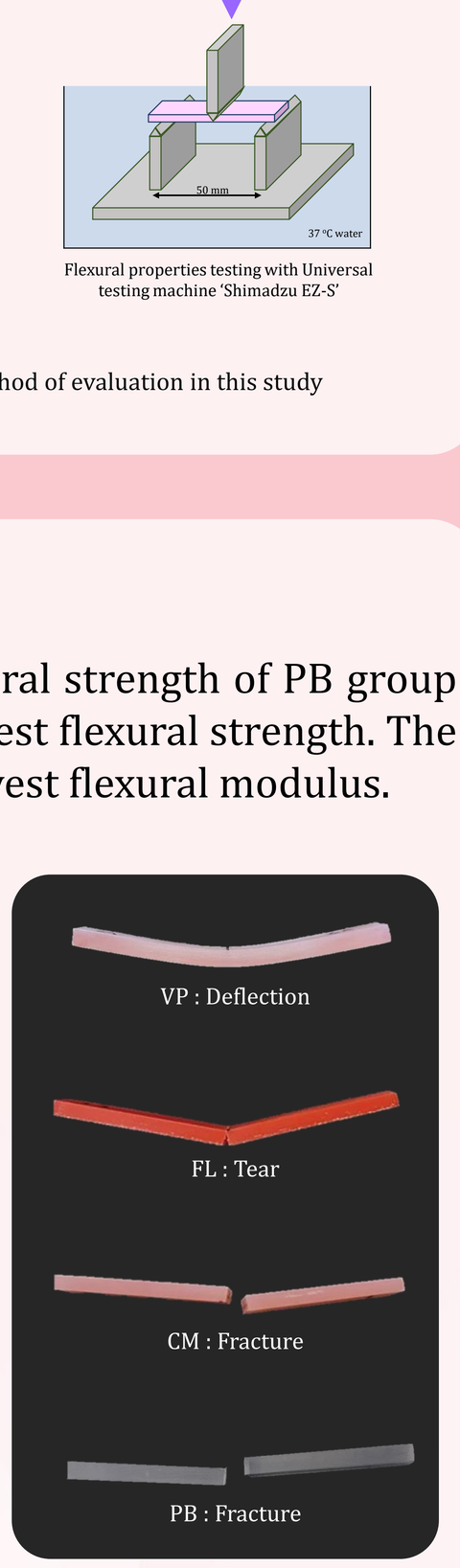


Figure 4 Mode of failure in each group

Conclusion

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