Synthesis of the bio-based alternative to Bis-GMA and its application to photo-polymerizable adhesives

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1. Introduction – Bisphenol A-glycidyl methacrylate (Bis-GMA) is a blockbuster photo-polymerizable compound usedinawide varietyofareas, ranging from encapsulants of electronic devices to resin-based dental materials [1,2]. Bis-GMA is a chemical compound containing a bisphenol A moiety, and there is controversy about its toxicity to human health. In this regard, many studies are focused on a substitute for Bis-GMA, particularly in dental materials. One of the most promising bio-based chemicals is isosorbide (1,4:3,6-dianhydro-D-sorbitol), which is prepared by dehydrating sorbitol obtained via reduction of glucose and is classified by the US Food and Drug Administration as a GRAS ("generally recognized as safe") material. In this presentation, we address the preparation of a bio-based, photopolymerizable compound from isosorbide (denoted as "Iso-GMA") as an alternative to Bis-GMA and its feasibility as a photo-polymerizable material.

2. Experimental – The details for the synthesis and the evaluations of isosorbide-glycidyl methacrylate (Iso-GMA) will be presented in a poster session.

3. Results and Discussion - Iso-GMA was synthesized from bio-based isosorbide via two step reactions to replace BisGMA, and its photo-polymerizing behaviors and mechanical properties after photo-polymerization were investigated. The viscosity of Iso-GMA was lower than that of Bis-GMA, and the glass transition temperature (Tg) of photo-polymerized Iso-GMA was relatively high (80.5 °C) although there was no aromatic moiety in the molecule. The photo-polymerizing pattern of Iso-GMA was analysed by photo-DSC and FTIR, and it showed a similar photo-polymerizing rate to Bis-GMA/triethylene glycol dimethacrylate (TEGDMA) composition (6:4, w/w). The shrinkage ratio of Iso-GMA during photo-polymerization was less than that of Bis-GMA/TEGDMA (5% vs 7.2%). In addition, the adhesion properties, compressive strength, and flexural properties of photo-polymerized IsoGMA were comparable to those of Bis-GMA/TEGDMA. Bio-based Iso-GMA could be a feasible alternative to problematic Bis-GMA that widely used in a variety of applications.

4. Conclusions - The photo-polymerizable compound with an isosorbide core attached by glycidyl methacrylates were synthesized as a bio-based and non-toxic alternative to Bis-GMA, and the photo-polymerizing behaviors and mechanical properties after photo-polymerization were investigated. Bio-based Iso-GMA could be a feasible alternative to problematic BisGMA that widely used in a variety of applications. On the basis of these results, further study on the composites of Iso-GMA for dental application is ongoing and it will be published elsewhere soon.

5. References

[1] Bratov A, Muñoz J, Dominguez C, Bartrolí J. *Sens. Actuators B*, **25**, (1995) p. 823.
[2] Ge J, Trujillo M, Stansbury J. *Dent. Mater.*, **21**, (2005) P. 1163.