Fabrication and Properties of PEKK-based Hybrid 3D Printable Dental Composite Resin

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Abstract and Introduction

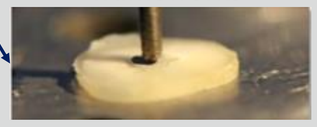
Poly aryl ether ketones (PAEKs) has now gradually become the leading polymer material in the fields of biomedical polymer, due to its good biocompatibility and high thermal, mechanical properties. Among PAEKs, PEKK has advantages such as higher thermal stability, better mechanical properties, versatile chemistry due to two ketone bonds compared to other PAEKs. We focused on poly(ether ketone ketone) based oligomer to improve the mechanical properties of dental resin. In this study, HEMA-terminated poly(ether ketone ketone) oligomer (CAEKK-HEMA) was synthesized using carboxylic acid-terminated poly(ether ketone ketone) oligomer (CA-EKK) and 2-Hydroxyethyl methacrylate (HEMA) and characterized by FT-IR, ^{1}H-NMR, and GPC. To investigate mechanical properties, the mixture of CAEKK-HEMA and ethoxylated bis-GMA (EBPDMA) with various ratios were photopolymerized by DLP 3D printer and their mechanical properties such as compressive and flexural strength were measured

- **High-temperature, high performance thermoplastic engineering plastics**
- **Good mechanical properties**
- **Resistance to chemicals (resistance to corrosion)**
- **Application : Fiber, Automotive, Aerospace, Electronics, Medical**

PEKK Dental application

Prosthetic materials

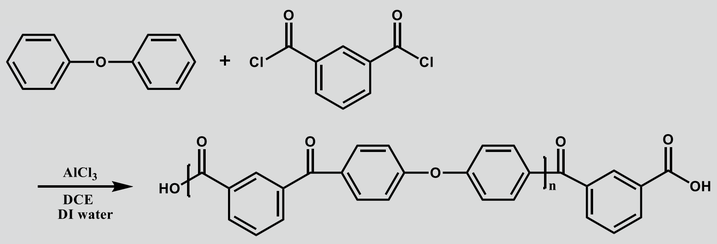
Removable denture frameworks



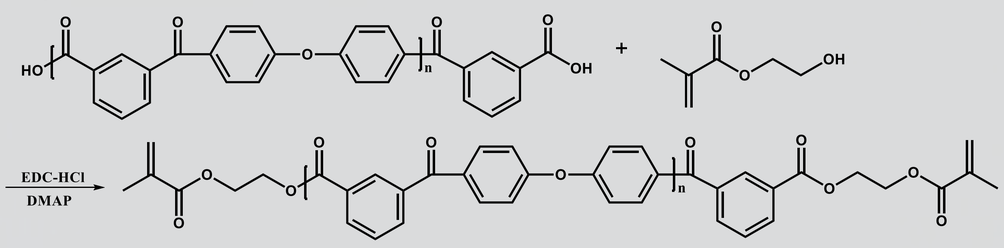
Endodontics posts and endo crowns

Experimental

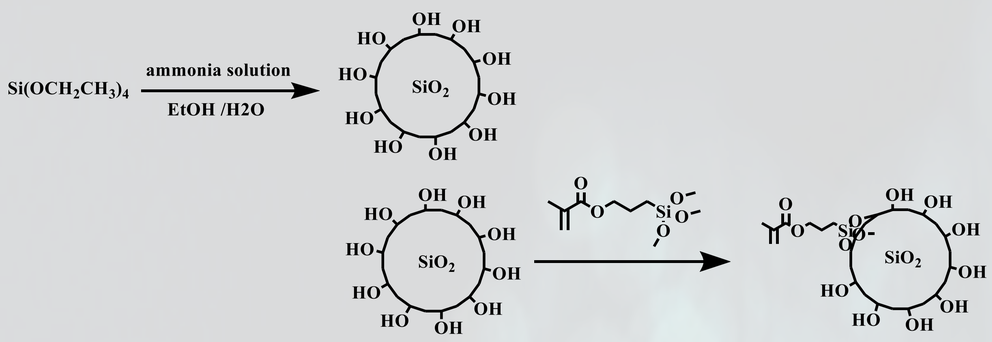
➢ Synthesis of CAEKK



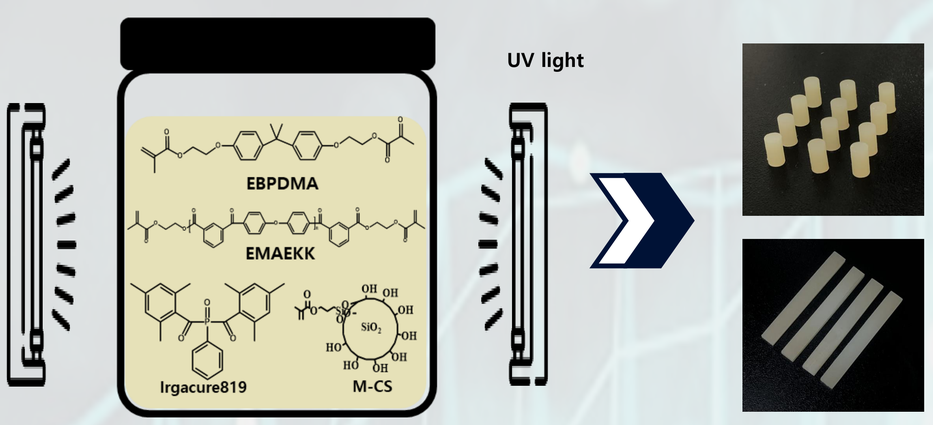
➢ Synthesis of EMAEKK



➢ Synthesis of Colloidal Silica Nanoparticle



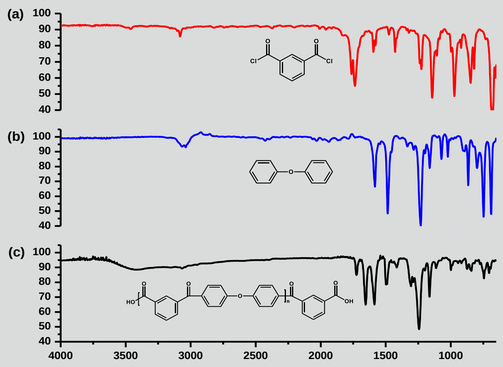
➢ Preparation of Photocurable Resin



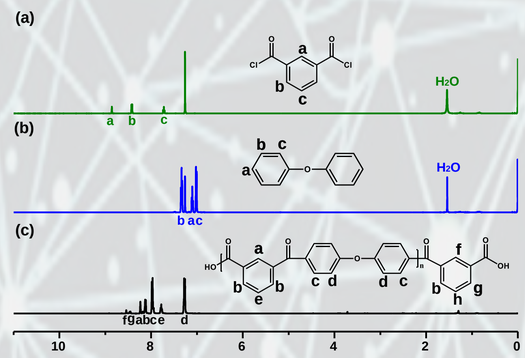
Result and Discussion

➢ Characterization of CAEKK

▪ FT-IR

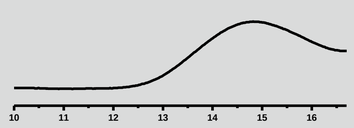


▪ ^{1}H NMR

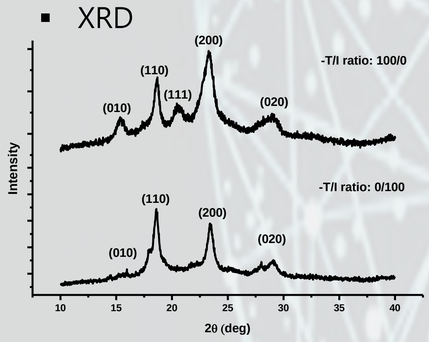


▪ GPC

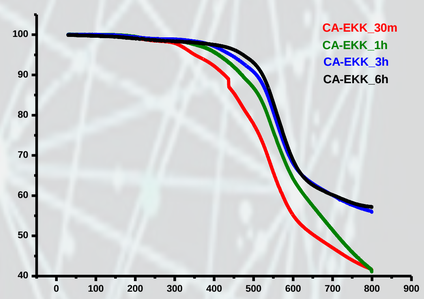
	Mn	PDI
CAEKK	14738g/mol	1.476



▪ XRD

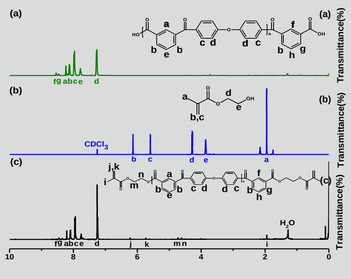


▪ TGA

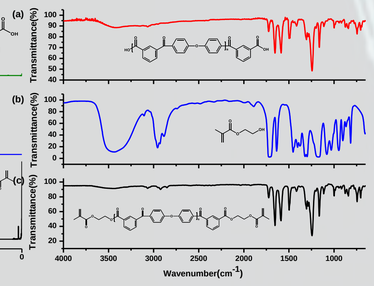


➢ Characterization of EMAEKK

▪ NMR

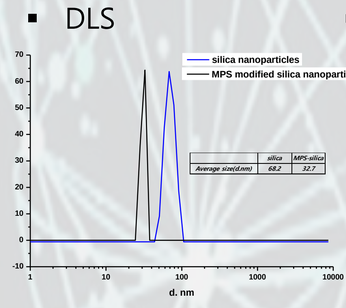


▪ FT-IR



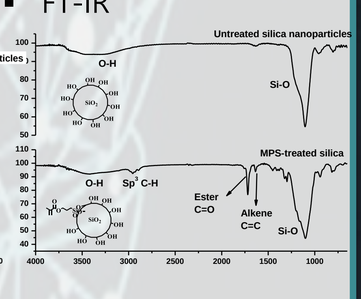
➢ MPS-modified Silica nanoparticle

▪ DLS

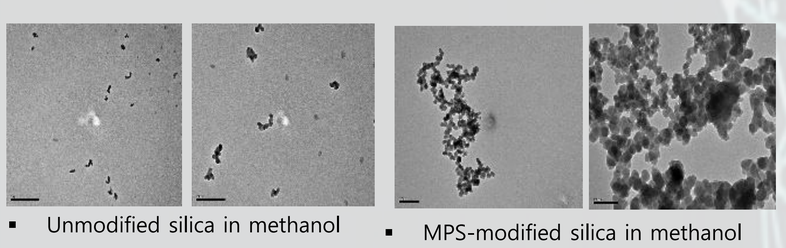


	silica	MPS-silica
Average size(d.nm)	68.2	32.7

▪ FT-IR

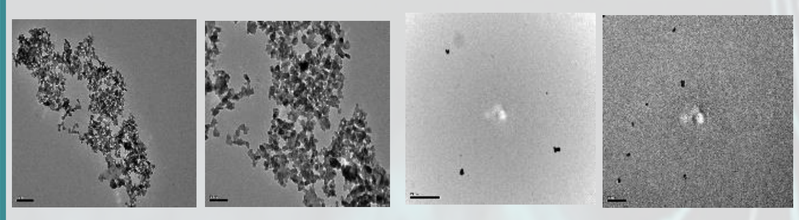


➢ Fracture surface observation of hybrid resin



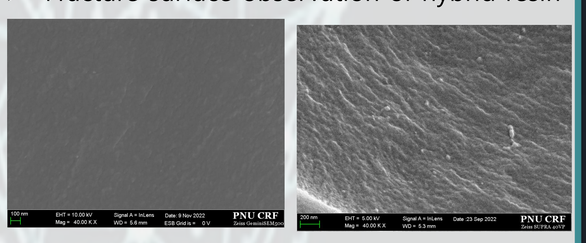
▪ Unmodified silica in methanol

▪ MPS-modified silica in methanol



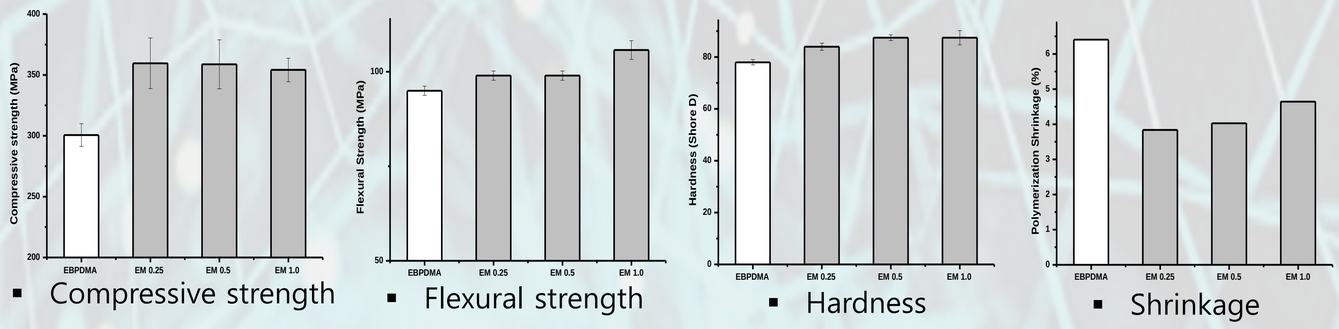
▪ Unmodified silica in acetone

▪ MPS-modified silica in acetone



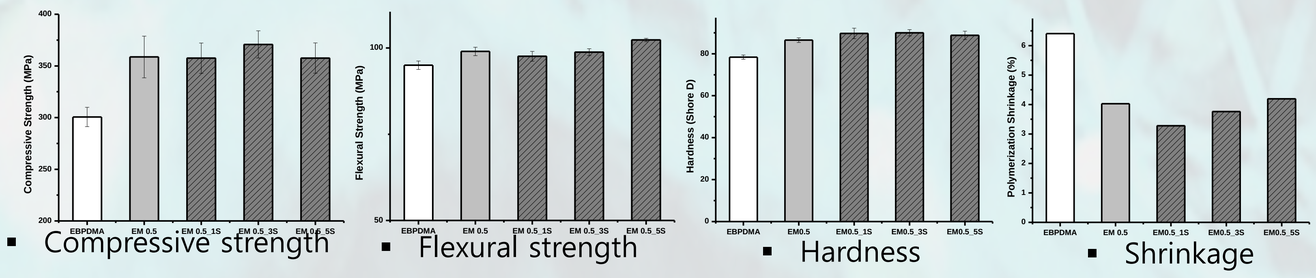
- The fracture surface of cured (a) unfilled resin and (b) resin filled with MPS-modified silica nanoparticles.
- Silica nanoparticles in cured dental resin are not agglomerated due to the organic fuctional group of the silane coupling agent.

➢ Mechanical properties of dental resins containing EMAEKK



▪ Compressive strength ▪ Flexural strength ▪ Hardness ▪ Shrinkage

➢ Mechanical properties of hybrid resins



▪ Compressive strength ▪ Flexural strength ▪ Hardness ▪ Shrinkage

Conclusion

In this study, Ethyl methacrylate-terminated PEKK (EMAEKK) was synthesized with carboxylic acid-terminated PEKK (CAEKK) and 2-hydroxyethyl methacrylate (HEMA). MPS-modified colloid silica nanoparticle was also synthesized. The characterization of CAEKK and EMAEKK was conducted by FT-IR, ^{1}H-NMR, GPC, XRD and TGA. The chemical structure and dimension of colloidal silica nanoparticle was measured by FT-IR, TEM and SEM. The compressive strength and flexural strength of dental resin containing EMAEKK was evaluated by UTM. Polymerization shrinkage and shord D hardness were also observed.

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