Mechanistic Insights into Xanthan Gum-Containing/Epoxy Functionalized Hybrid Poly(HEMA-co-GMA) Gels with Enhanced Salt-Resistive Properties

Mertcan ER[1,2], Nermin ORAKDOGEN[1]

[1] Istanbul Technical University, Department of Chemistry, Soft Materials Research Laboratory, Maslak, 34469, Istanbul, Turkey
[2] Istanbul Technical University, Graduate School, Maslak, 34469, Istanbul, Turkey
E-mail: mertcaner@itu.edu.tr, orakdogen@itu.edu.tr

Motivation & Aim

- ✓ In this study, semi-interpenetrating networks strategy was used to design hybrid gels with improved mechanical and physical properties.
- ✓ Synergistic effects between biopolymer Xanthan Gum (XG) and chemically cross-linked network based on biocompatible 2-hydroxyethyl methacrylate (HEMA), glycidyl methacrylate (GMA) and di(ethylene glycol) dimethacrylate utilized to create advanced gels with enhanced properties.
- ✓ One of the hypotheses of the study was to investigate the effect of the synergistic phenomenon on material properties such as composition-dependent swelling and elastic modulus by synthesizing polymer gels at constant XG w/w% concentration while varying the GMA mol% amount in the gelation feed and keeping the preparation temperatures at 24 °C and -18 °C, respectively.

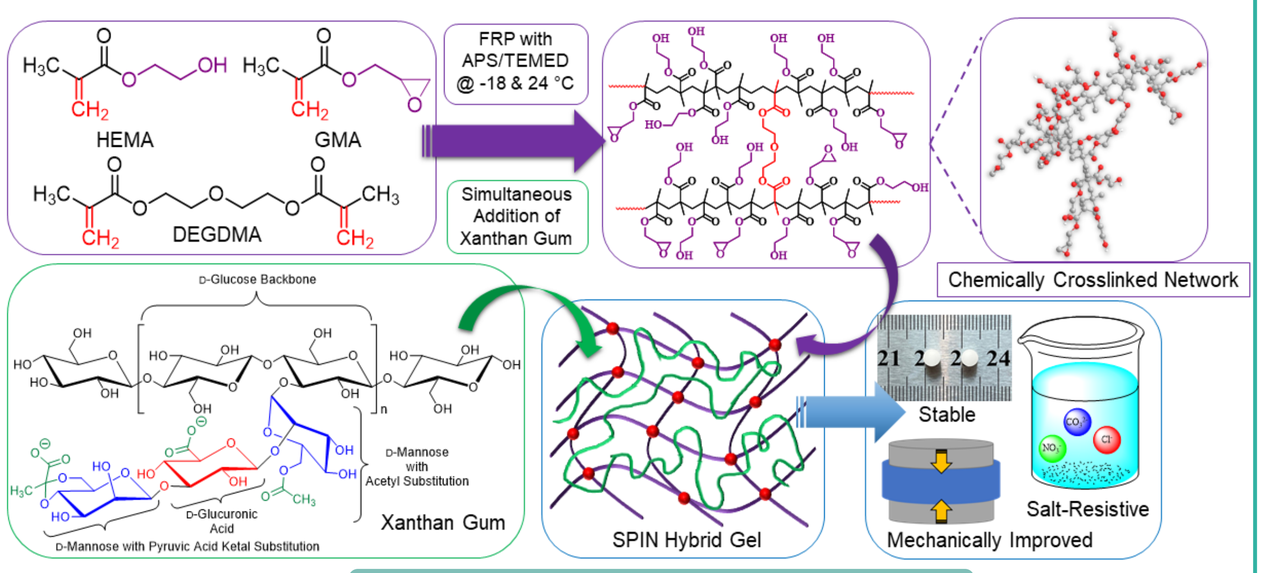
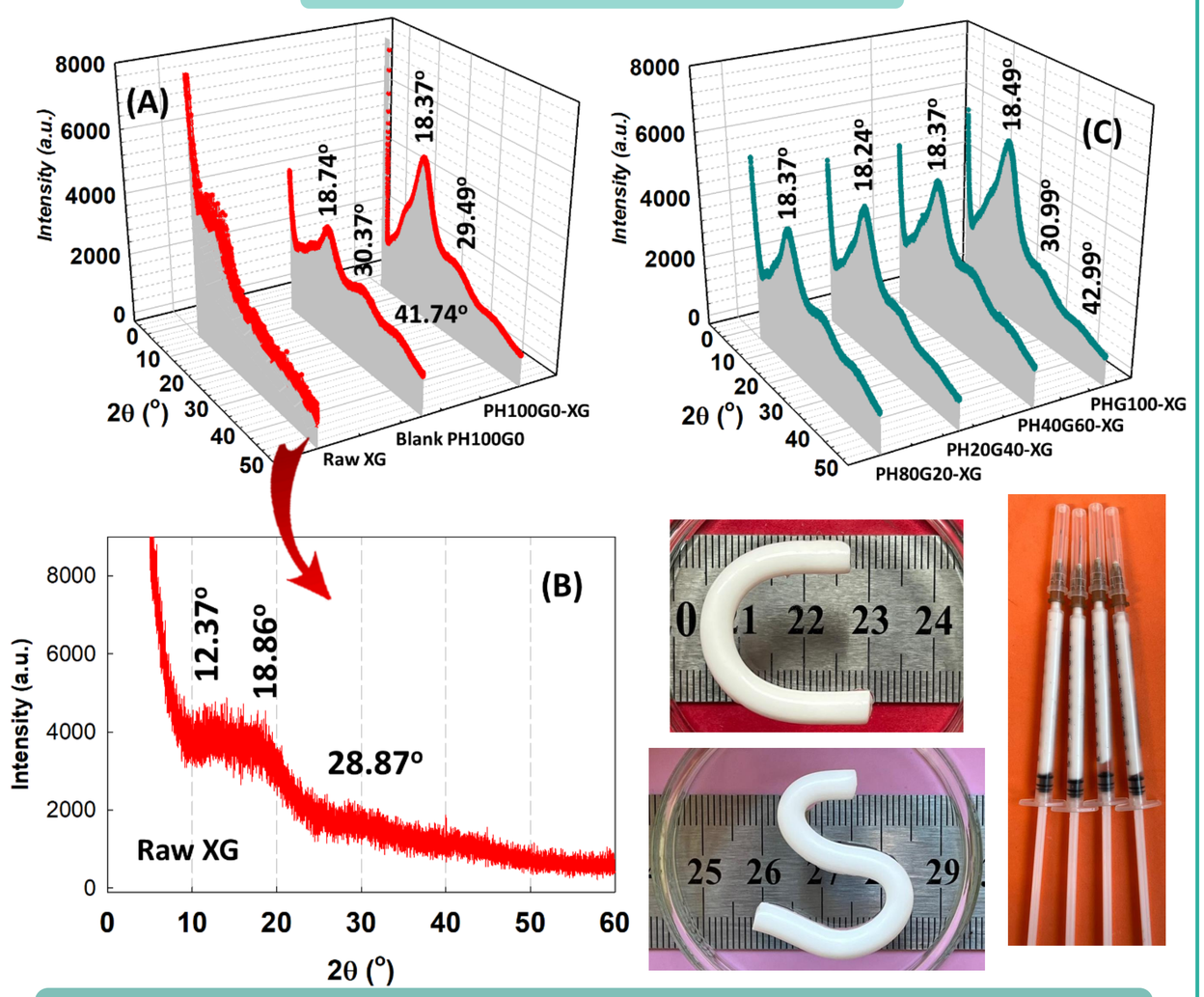


Illustration of proposed network structure.

Chemical Structure: XRD

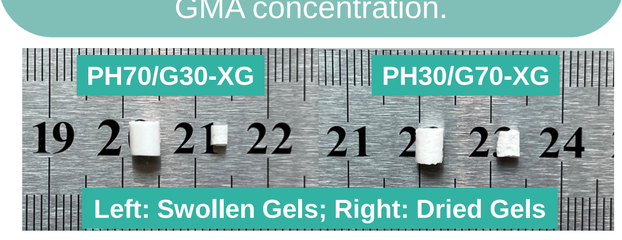


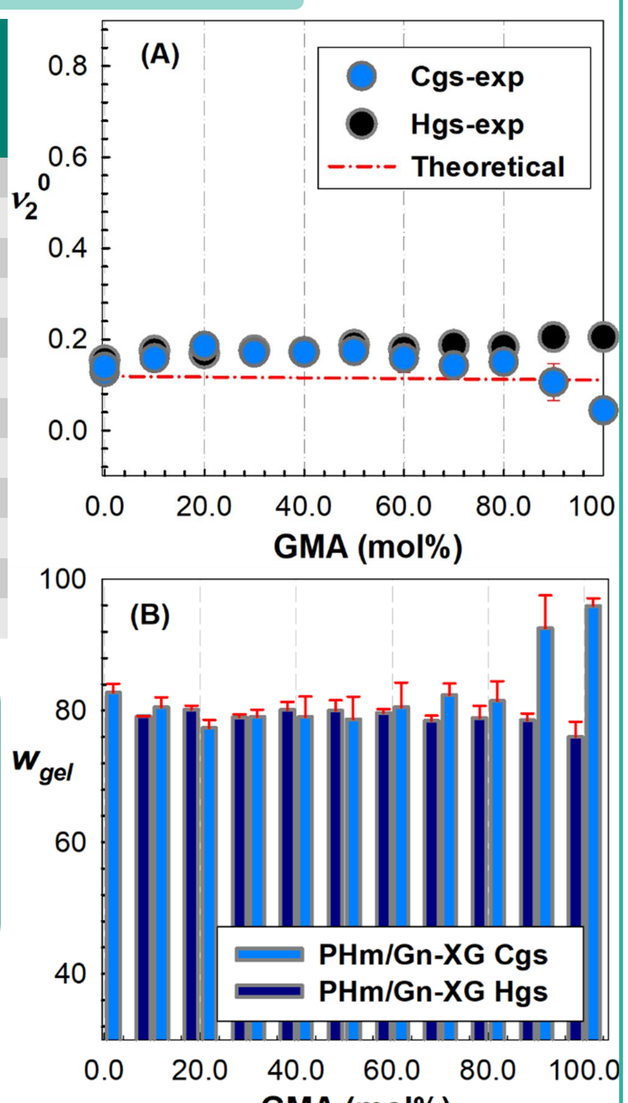
XRD curve of (A, B) raw XG, Blank PH100G0, PH100G0-XG and (C) PHm/Gn-XG gels at various GMA content. Digital photos of varios gels at as-prepared state.

Experimental

Prepared Sample PHm/Gn-XG	HEMA/GMA mol% ratio (m/n)	XG w/v%
Blank PH100/G0	100/0	0
PH100/G0-XG	100/0	0.1
PH90/G10-XG	90/10	0.1
PH80/G20-XG	80/20	0.1
PH70/G30-XG	70/30	0.1
PH60/G40-XG	60/40	0.1
PH50/G50-XG	50/50	0.1
PH40/G60-XG	40/60	0.1
PH30/G70-XG	30/70	0.1
PH20/G80-XG	20/80	0.1
PH10/G90-XG	10/90	0.1
PH0/G100-XG	0/100	0.1

Table showing composition of XG-PHm/Gn gels with different GMA content. Fig.(A) Comparison of experimentally determined volume fraction of crosslinked network after preparation-state, v_2^0, and Fig.(B) gel fraction, w_{gel} of PHm/Gn-XG gels as a function of the GMA concentration.



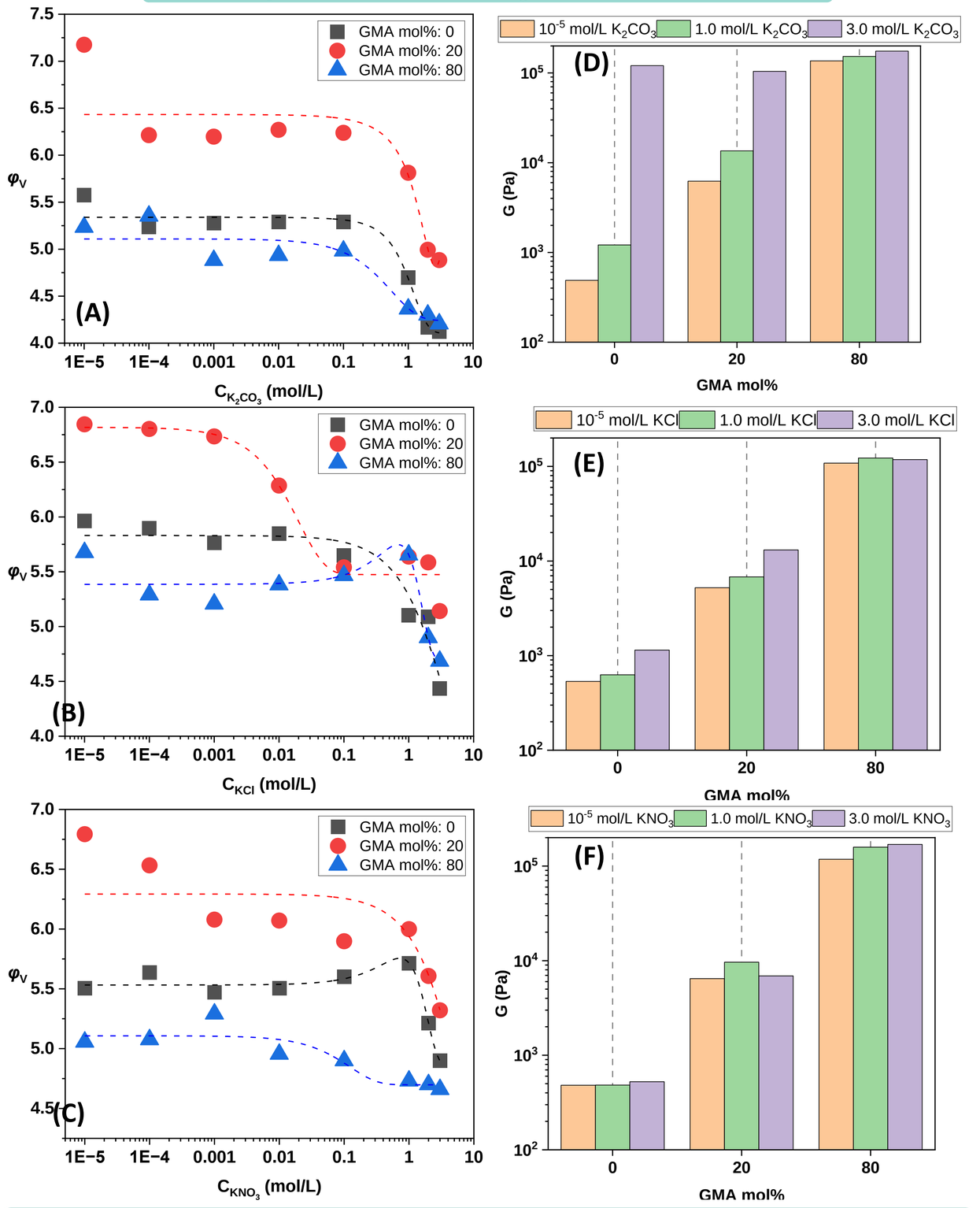


Digital Photos of Equilibrium Swollen Gels

Mechanical Properties

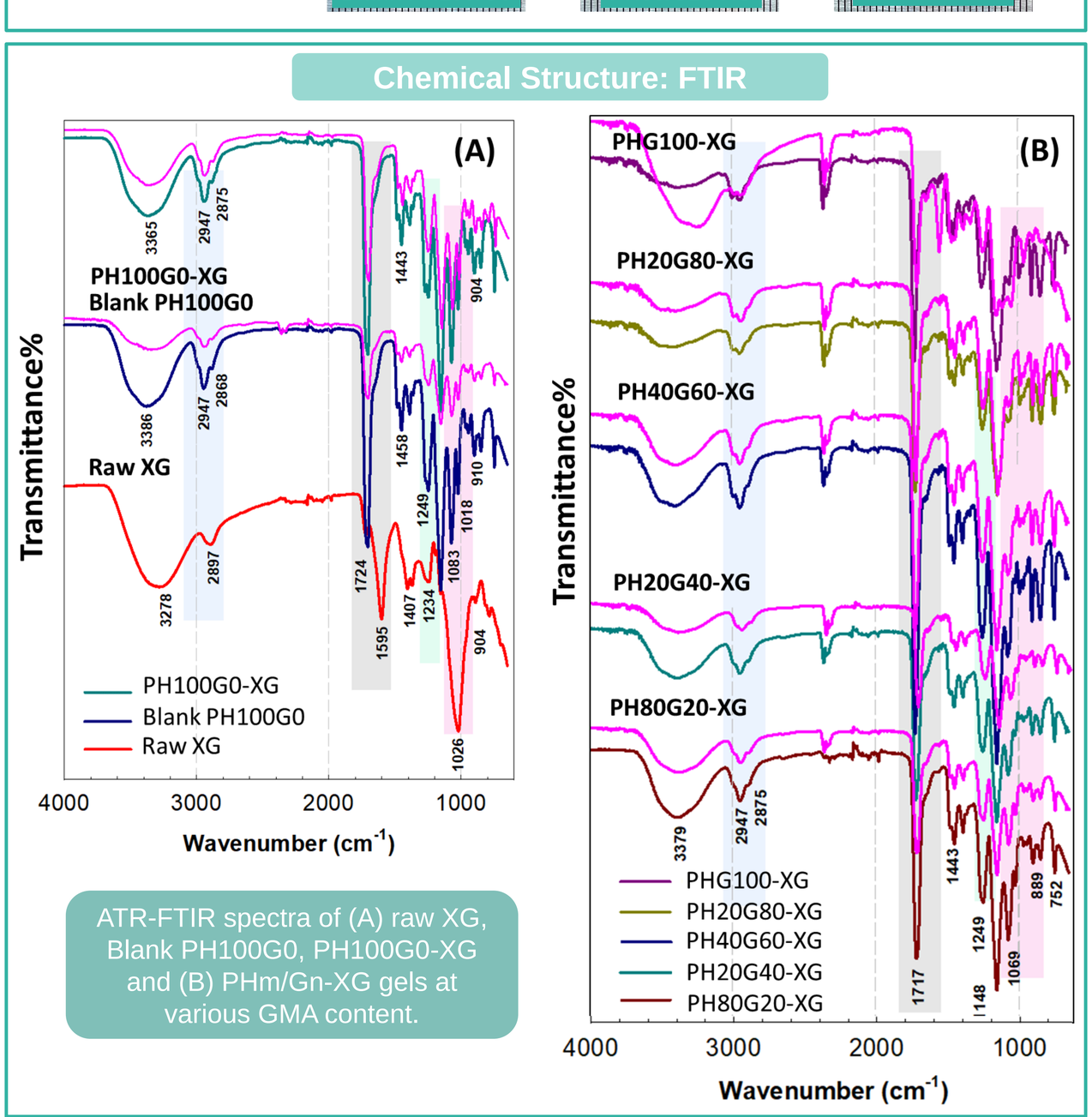
(A) Variation of swollen elastic modulus of PHm/Gn-XG gels at various GMA content after equilibrium swelling in water. (B) Comparison of compressive moduli of PHm/Gn-XG gels after preparation and after equilibrium swelling in water with respect to GMA concentration.

Salt-Dependent Swelling & Elastic Modulus



(A-C) Swelling ratio of PHm/Gn-XG gels at various GMA content after equilibrium swelling in aqueous solutions of K_2CO_3, KCl, and KNO_3. (D-F) Swollen elastic modulus of PHm/Gn-XG gels at various GMA content after equilibrium swelling in same solutions.

Chemical Structure: FTIR



ATR-FTIR spectra of (A) raw XG, Blank PH100G0, PH100G0-XG and (B) PHm/Gn-XG gels at various GMA content.

Conclusions

- ✓ With improved mechanical, salt-resistant and stable properties, Poly(HEMA-co-GMA)/XG-based Semi-interpenetrating polymer networks gels offer a promising template scaffold for medical research.

Acknowledgements

- ✓ This study was conducted by Istanbul Technical University Graduate School and supported as part of the PhD thesis entitled «Design Strategies and Structure-Property Relationships of Soft Materials Based on Functional Poly(N-alkyl methacrylate) Hybrid Gels».