Supporting Information

Multifunctional and Stimuli-Responsive Ionic Liquid-Polymeric Hydrogel: A Promising Platform for Co-Drug Delivery in Cancer Treatment

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Table S1: Comparative analysis of drug-loaded hydrogel systems reported in the past years highlighting the performance of the developed IL-polymeric hydrogel.

Study (Author, Year)	System	Drug(s) Used	Result	Ref.
Pooresmaeil et al., 2019	CMC/LDH(Zn/Al)	5-FU	Showed the controlled 5-Fu delivery to the colon	[1]
Emani et al., 2023	Chitosan-1,3,5-benzene tricarboxylic acid hydrogel	5-FU	Potential applications in the sustained release of cancer therapeutics	[2]
Pansuriya et al., 2023	[Ch][Ol]-PVA Glycerol-Dextrose-Borax hydrogel	5-FU	Develop a self-assembled structure that encapsulates anticancer drugs	[3]
Abbasi et al.,	CMC-AMPS-MBA	Diferourylmethane	Deliver hydrophobic	[4]

2023	hydrogel		drugs to colorectal cancer cells	
Jain et al., 2024	[Ch][Ol]-NaCl hydrogel	DOX		[5]
Yuan et al., 2025	Silk fibroin-PEG hydrogel	5-FU-Curcumin	Adjuvant therapeutic strategy for colorectal cancer	[6]
This work	[TMG][Ol]-PVA-SA	5-FU-Hp	Offering a new avenue for effective cancer therapy and metastasis suppression	

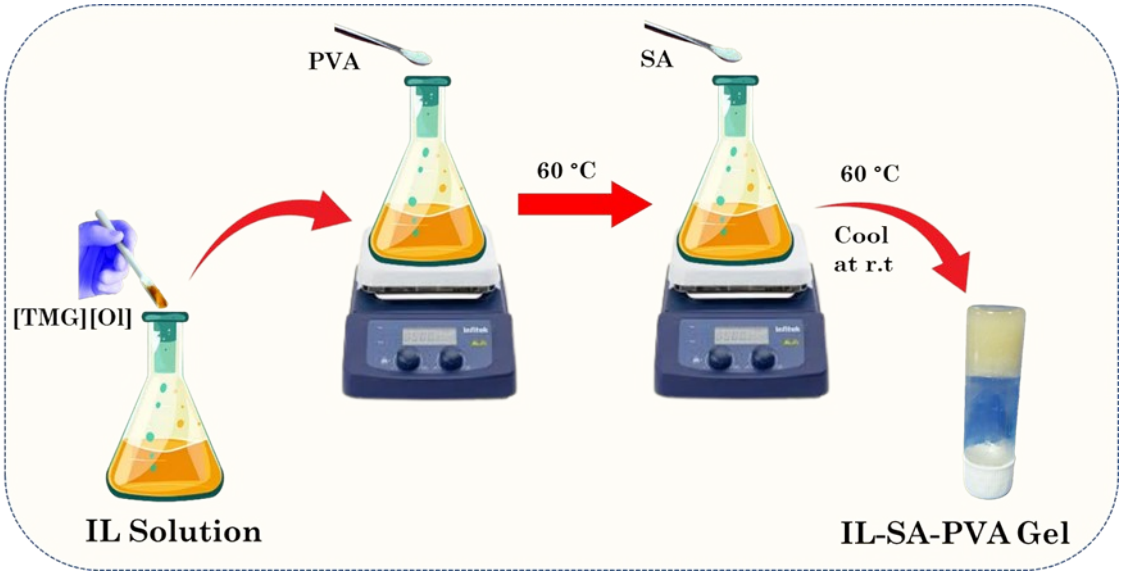

Figure S1: Schematic illustration for preparing the hydrogel

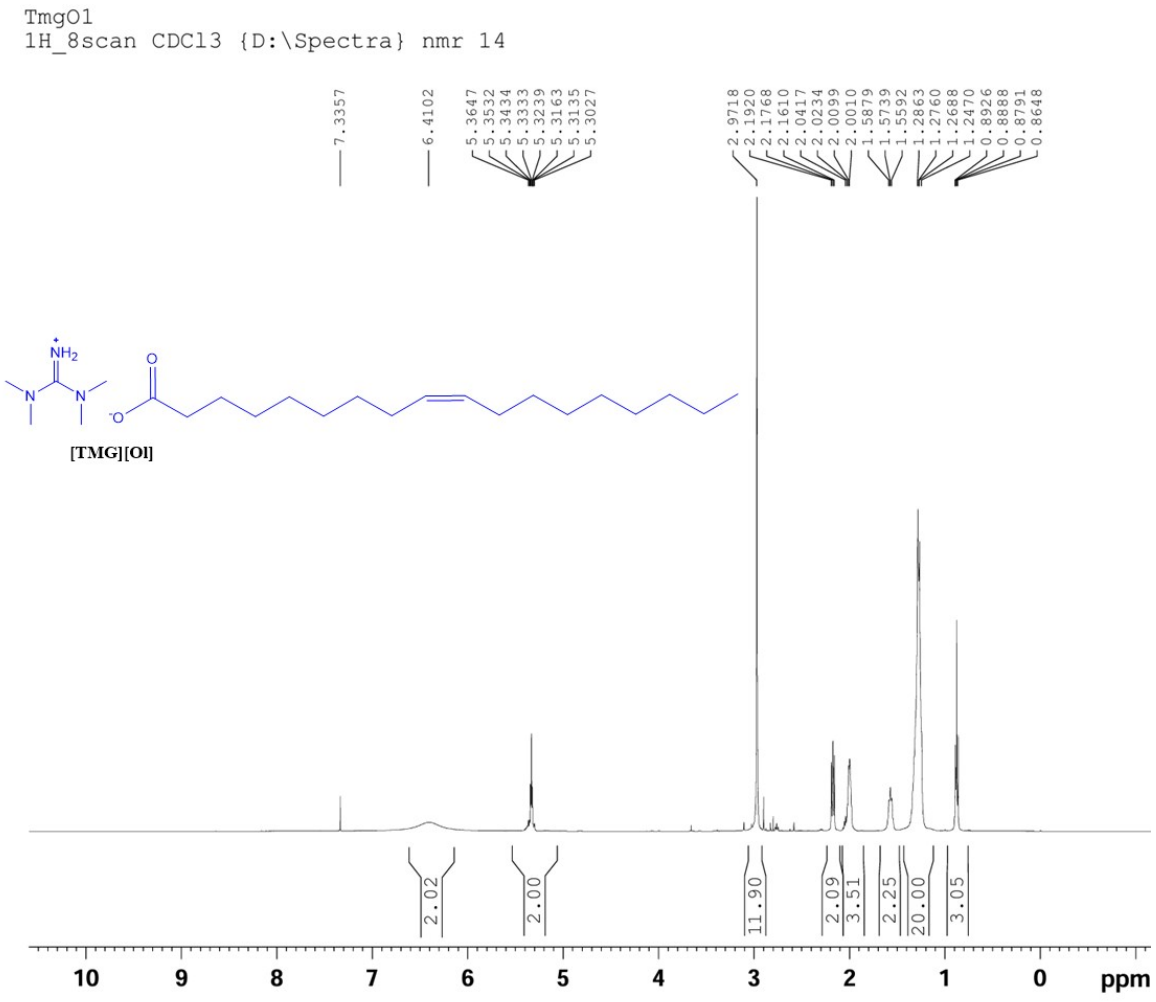

Figure S2: 1H NMR spectrum of [TMG][Ol]

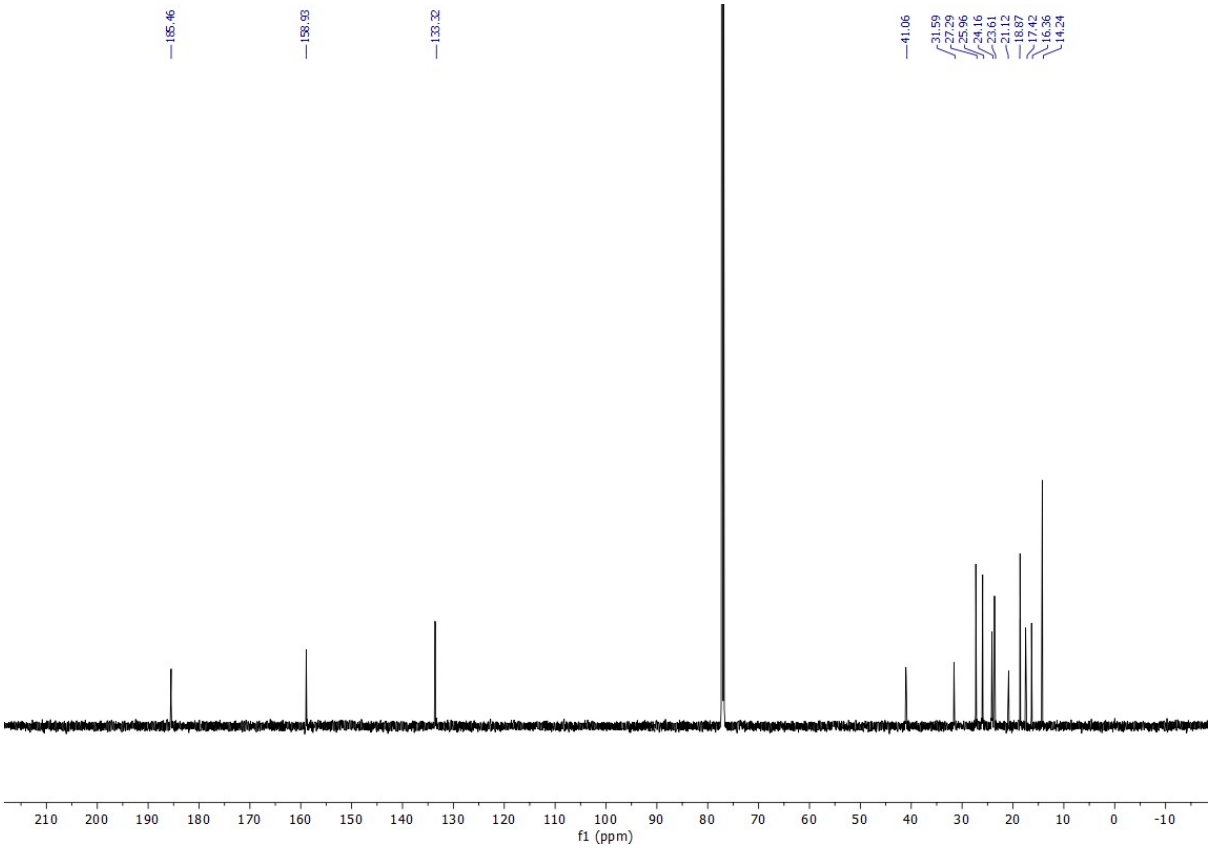

Figure S3: 13C NMR spectrum of [TMG][Ol]

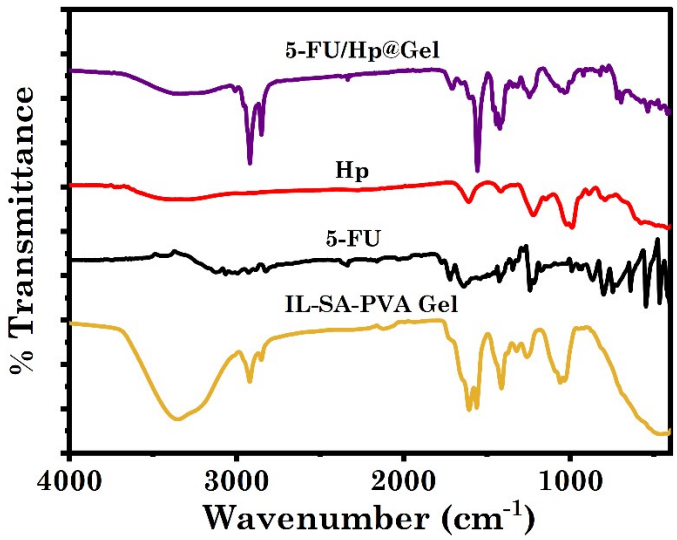

Figure S4: FT-IR spectra of IL-SA-PVA Gel, 5-FU, Hp and 5-FU/Hp@ IL-SA-PVA Gel

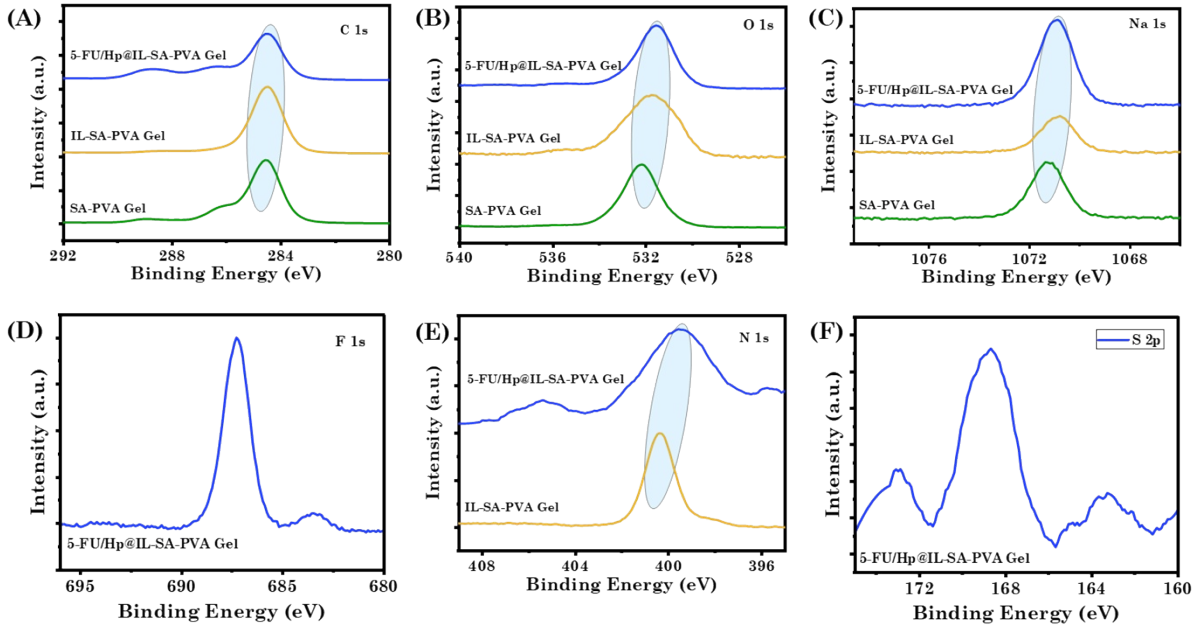

Figure S5: High-resolution XPS spectra of (A) C 1s (B) O 1s (C) Na 1s (D) F 1s (E) N 1s (F) S 2p

Table S2: XPS atomic data analysis

Elements	SA-PVA Gel	IL-SA-PVA Gel	5-FU/Hp@ IL-SA-PVA Gel
C 1s %	78.65	91.4	64.85
O 1s %	20.02	7.3	15.34
Na 1s %	1.33	0.91	1.6
N 1s	-	0.4	12.3
F 1s	-	-	5.32
S 2p	-	-	0.6

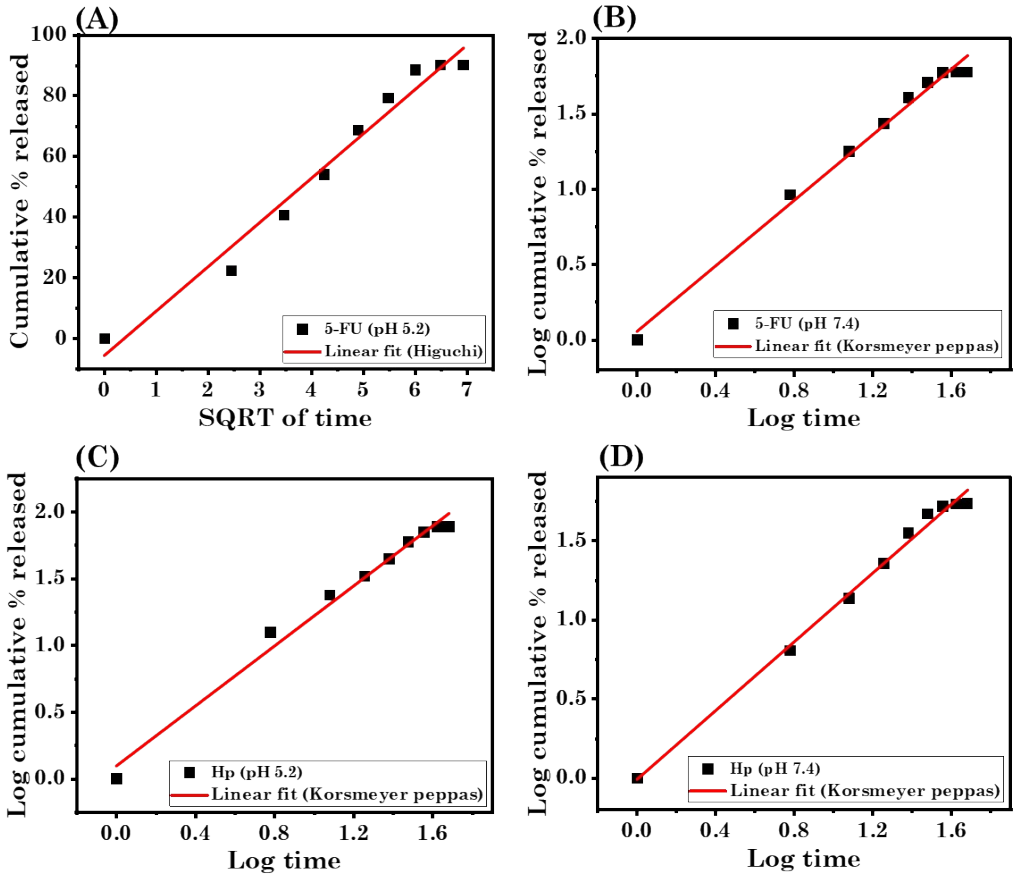

Figure S6: 5-FU release fitting model at (A) pH 5.2 (B) pH 7.4; Hp release fitting model at (C) pH 5.2 (D) pH 7.4

Table S3: Mean Cumulative Release Rates of 5-FU/Hp@IL-SA-PVA Gel in pH 5.2 and 7.4

Model used	**5-FU release (pH 5.2)**	**5-FU release (pH 7.4)**	**Hp release (pH 5.2)**	**Hp release (pH 7.4)**
Zero Order kinetics	y = 1.9028x + 13.633 R^2 = 0.9202	y = 1.3822x + 2.9156 R^2 = 0.9506	y = 1.7356x + 2.6689 R^2 = 0.9797	y = 1.2806x + 1 R^2 = 0.9523
First order kinetic	y = -0.0236x + 2.0313	y = -0.0095x + 2.008	y = -0.015x + 2.0464	y = -0.0082x + 2.0122

	$R^2 = 0.9740$	$R^2 = 0.9601$	$R^2 = 0.9713$	$R^2 = 0.9598$
Higuchi	**y = 14.618x – 5.5735** **$R^2 = 0.9742$**	y = 10.18x – 9.0912 $R^2 = 0.9249$	y = 12.628x – 11.718 $R^2 = 0.9302$	y = 9.3313x – 9.6783 $R^2 = 0.907$
Korsmeyer-peppas	y = 1.1401x + 0.215 $R^2 = 0.94$	**y = 1.0872x – 0.0575** **$R^2 = 0.9903$**	**y = 1.1238x + 0.097** **$R^2 = 0.9859$**	**y = 1.0864x – 0.0069** **$R^2 = 0.9929$**
Hixson crowell	y = 0.0569x + 0.0719 $R^2 = 0.9741$	y = 0.0289x – 0.003 $R^2 = 0.9592$	y = 0.0418x – 0.0687 $R^2 = 0.9812$	y = 0.0256x – 0.0191 $R^2 = 0.9587$

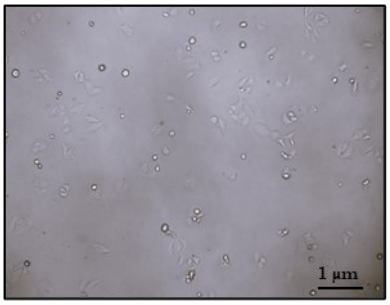

Figure S7: *In vitro* cytotoxicity of 5-FU/Hp@IL-SA-PVA Gel on the HaCaT cells (Scale: 1 µm)

References

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