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Dispersant Blending Strategy for Concentrated $LiMn_xFe_{1-x}PO_4$ Electrode Slurries

Seong Lee[1], Cheolheon Hyun[1], Woohyeon Jo[1], Jaewook Nam[1,2,*]
(*jaewooknam@snu.ac.kr)

[1]Department of Chemical and Biological Engineering, Seoul National University, Seoul, Republic of Korea
[2]Institute of Chemical Process, Seoul National University, Seoul, Republic of Korea

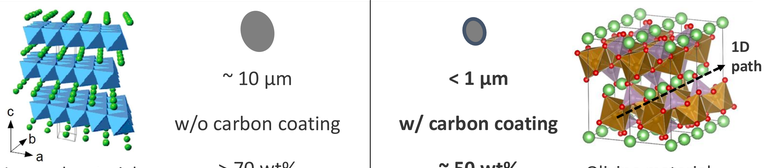
MCPL 미세유체 및 코팅공정 연구실 Microfluidics and Coating Process Laboratory

#1 Introduction

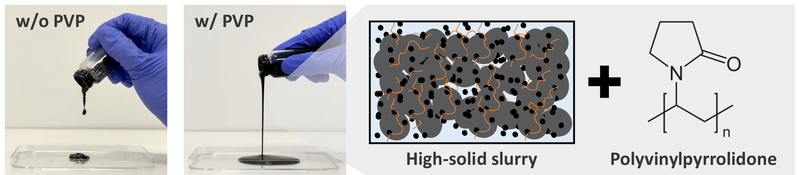
Challenges in LMFP slurry preparation

LMFP : Super P : PVDF = 90 : 5 : 5 in NMP

$Li(Ni_xCo_yMn_{1-x-y})O_2$	$LiMn_xFe_{1-x}PO_4$
~ 10 μm	< 1 μm
w/o carbon coating	w/ carbon coating
> 70 wt%	~ 50 wt%
Layered material	Olivine material



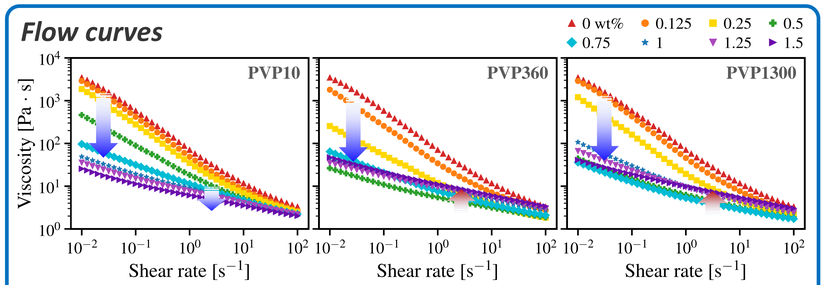
- Sub-micron particles and carbon coating induce ***agglomeration***
- Dispersants are used to obtain ***high-solid-content, uniform slurries***
- Effects of ***PVP MW*** and ***content*** on dispersion remain unclear



*"Elucidating **the role of PVP** in slurry rheology and microstructure is the key to a **dispersant strategy**"*

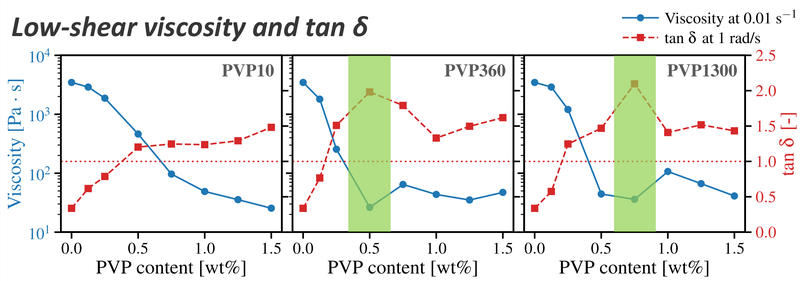
#2 Dispersion of LMFP Slurries by PVP

Flow curves



- PVP10: monotonic decrease; ***PVP360/1300: minima*** at 0.5–0.75 wt%

Low-shear viscosity and tan δ



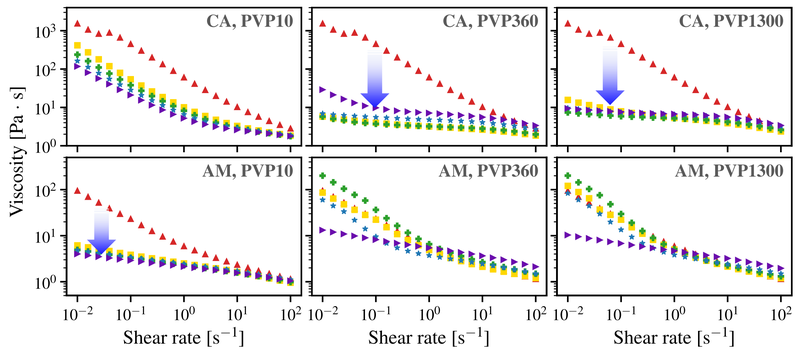
- PVP weakens the ***particle network*** by dispersing agglomerates
- Higher-MW: ***adsorption saturation*** → excess chains form a network

*"**Dispersion behavior** of LMFP slurries **varies with PVP MW**"*

#3 Mechanism via Model Suspensions

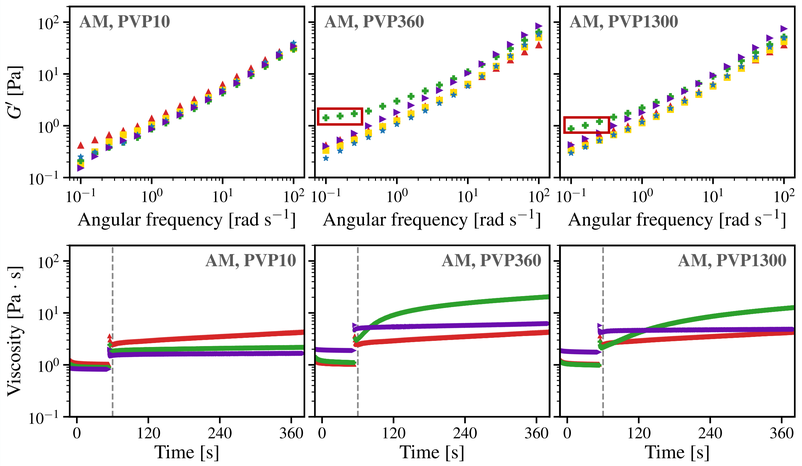
Model suspension rheology

CA: conductive additive, AM: active material



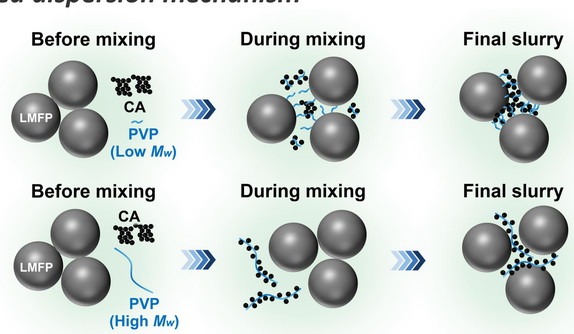
- CA: PVP360/1300 Newtonian from 0.25 wt% → strong adsorption
- AM: PVP10 monotonic decrease; inter-particle bridging by long chains

Signatures of bridging in AM suspensions



- PVP360/1300: G′ jumps at 0.5 wt%, ***G′ ~ ω^n*** with ***n = 0.22–0.37***
- Slow recovery after step-down; ***τ_{90} = 130–220 s*** vs < 10 s

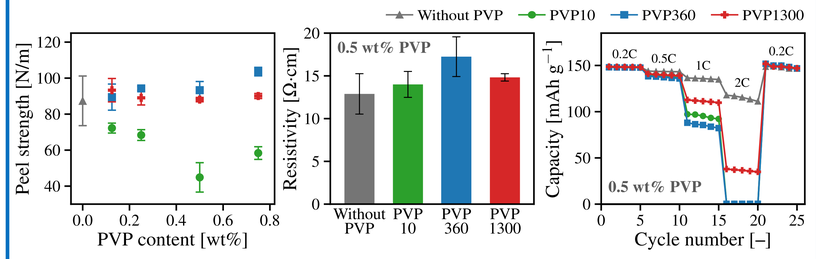
Proposed dispersion mechanism



- ***Lower-MW***: adsorbs onto ***both LMFP/CA***; directly promotes dispersion
- ***Higher-MW***: preferentially onto ***CA***; no bridging in the full slurry

#4 Influence on Electrode Performance

Adhesion, electrode resistance and cell performance

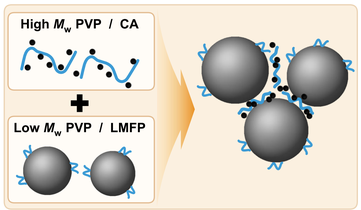


- PVP10 on LMFP hinders PVDF adsorption → adhesion halved
- PVP raises resistance & degrades rate capability regardless of MW

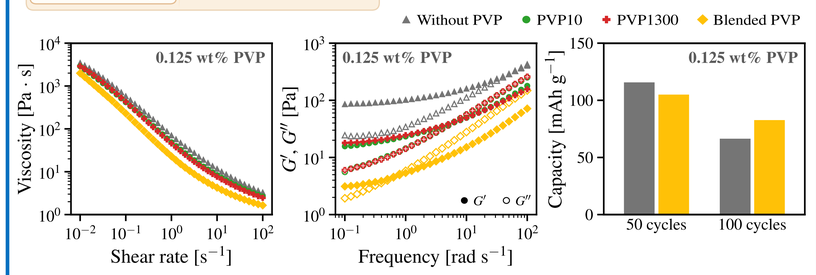
*"***Trade–off** between slurry dispersion and electrochemical performance"*

#5 Blending Strategy

Selective adsorption by addition sequence



- PVP1300 in CA dispersion step
- PVP10 upon LMFP addition
- 0.0625 wt% each
  → ***0.125 wt%*** in total (1/4 of 0.5 wt%)



- Slurry dispersion secured with ***far less PVP***
- Performance penalty of PVP minimized; better cycle retention

#6 Final Remarks

- Dispersion mechanism depends on molecular weight of PVP
- Slurry rheology resolves the dispersion state and its mechanism
- PVP forms an insulating layer → dispersion–performance trade–off
- Dispersant blending: selective adsorption by addition sequence
- Guide to dispersant choice & sequence for high-solid slurries