POLYMER ELECTROLYTES DERIVED FROM CHEMICALLY MODIFIED NATURAL RESOURCES

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Electrolytes are the heart of electrochemical devices

Initially,

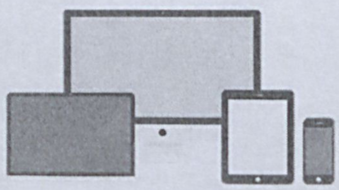
Liquid electrolyte was used in electrochemical devices.

→

However...

Drawbacks of liquid electrolyte:

- **Liquid leakage of solvent**
- **Internal short**



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1975

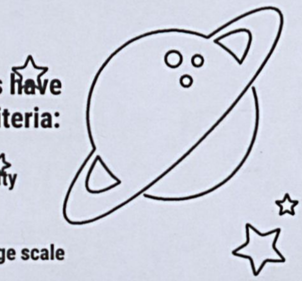
Wright has discovered ionic conduction in polymer

Polymer electrolyte rapidly gained its position in electrochemistry

Polymers have been formulated as electron or ion conductors and are used mainly in conventional electrochemical devices and emerging flexible devices

Various synthetic polymers have been experimented with criteria:

- high electrical conductivity
- corrosion resistant
- minimal thickness
- easy to be manufactured at large scale



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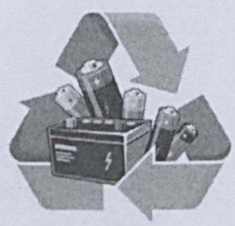
SYNTHETIC POLYMER ELECTROLYTES

- **Lithium salt complexed -poly(ethylene oxide) (PEO)**
- **Lithium salt complexed -poly(propylene oxide) (PPO)**
- **Salt complexed-polymethylmethacrylate (PMMA) gel electrolyte**

Difficult to be degraded in nature

POLLUTION!

SMARTER AND GREENER
alternatives are needed!



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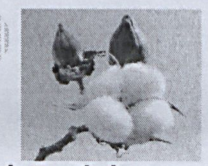
abundant in nature

economical

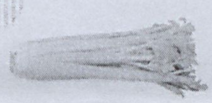
biodegradable

NATURAL

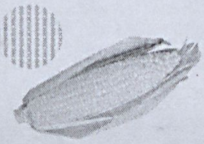
POLYMER ELECTROLYTES



Hydroxyethyl cellulose

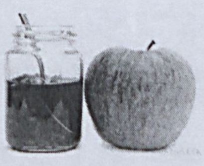


Cellulose based

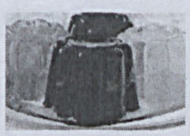


Starch based

Polysaccharides are best candidate due to their abundance in environment

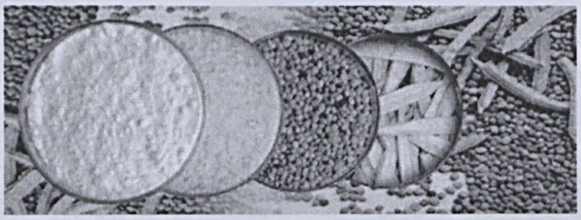


Pectin



Agar based

Chitosan based



Natural polymers

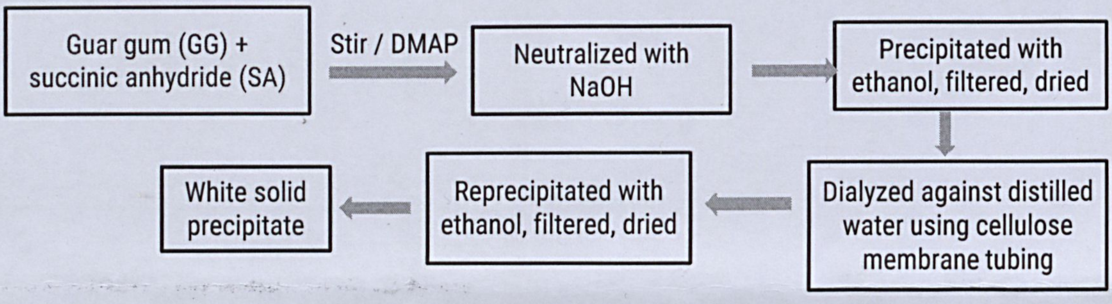
- Has high degree of crystallinity
- Hard to be dissolved and tend to form clump in water

☆ Need to be modified via esterification to serve its function as polymer electrolyte

OBJECTIVES

To modify guar gum chemically by **succination** in order to increase its solubility and amorphousness for use as polymer electrolyte

SYNTHESIS OF GUAR GUM SUCCINATE



Modified GGS and their feed ratio composition

Designation	GG:SA (mmol)
GGS_1	1:1
GGS_7	1:7
GGS_{14}	1:14

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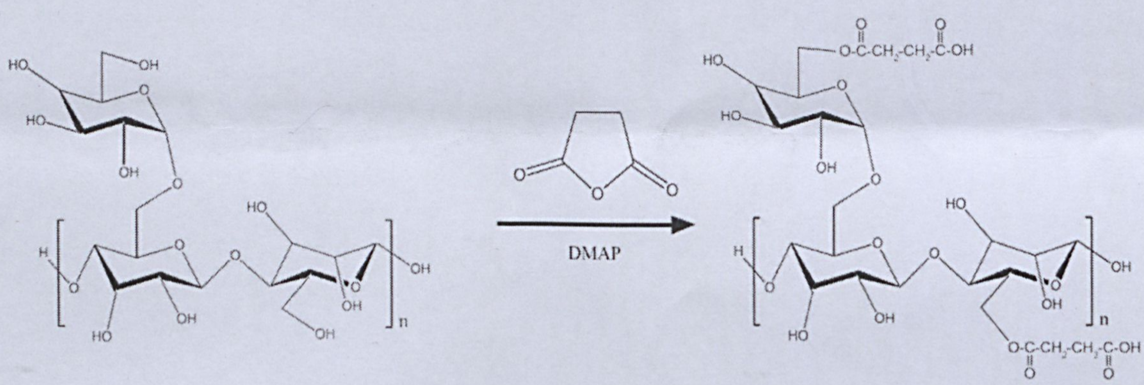

Succination of guar gum (Seeli et al., 2016)

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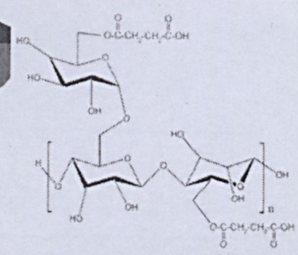
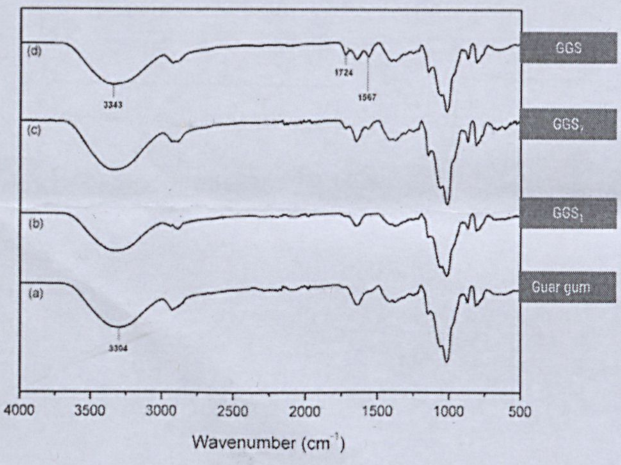
FOURIER TRANSFORM INFRARED SPECTROSCOPY (FTIR)





Wavenumber (cm^{-1})	Functional Group
3600-3100	-OH stretchin
2930-2890	Aliphatic C-H stretching
1724	Carbonyl group in ester linkage
1647	COO- symmetric stretching
1567	Unsymmetrical stretching of carboxylic anion
1378	CH_2 group bending
1225-817	C-C-O, C-OH,C-O-C stretching of GG backbone
1018-872	C-O-C stretching of glycosidic linkages

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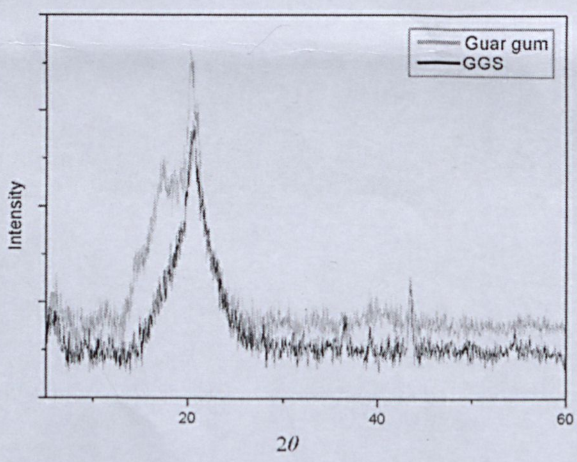
X-RAY DIFFRACTION (XRD)



- Peaks at 17.46° and 20.28° (2θ) with relative intensities of 75 and 100, in agreement with previous literature (2016, Seeli)
- Peak at 17.46° has diminished and peak at 20.28° has decreased in intensity
- New peak at 43.42°
- Broad peak => more amorphous

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CONCLUSION

- GGS was successfully synthesized and its structure has been verified via FTIR spectroscopy by the appearance of two major new peaks at 1724 cm^{-1} and 1567 cm^{-1}.
- GGS is easier to dissolve in water compared to neat guar gum
- The XRD analysis showed that the intensity of peak 20.28° has decreased and peak 17.46° has diminished proving that the GGS is more amorphous than the neat guar gum.

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