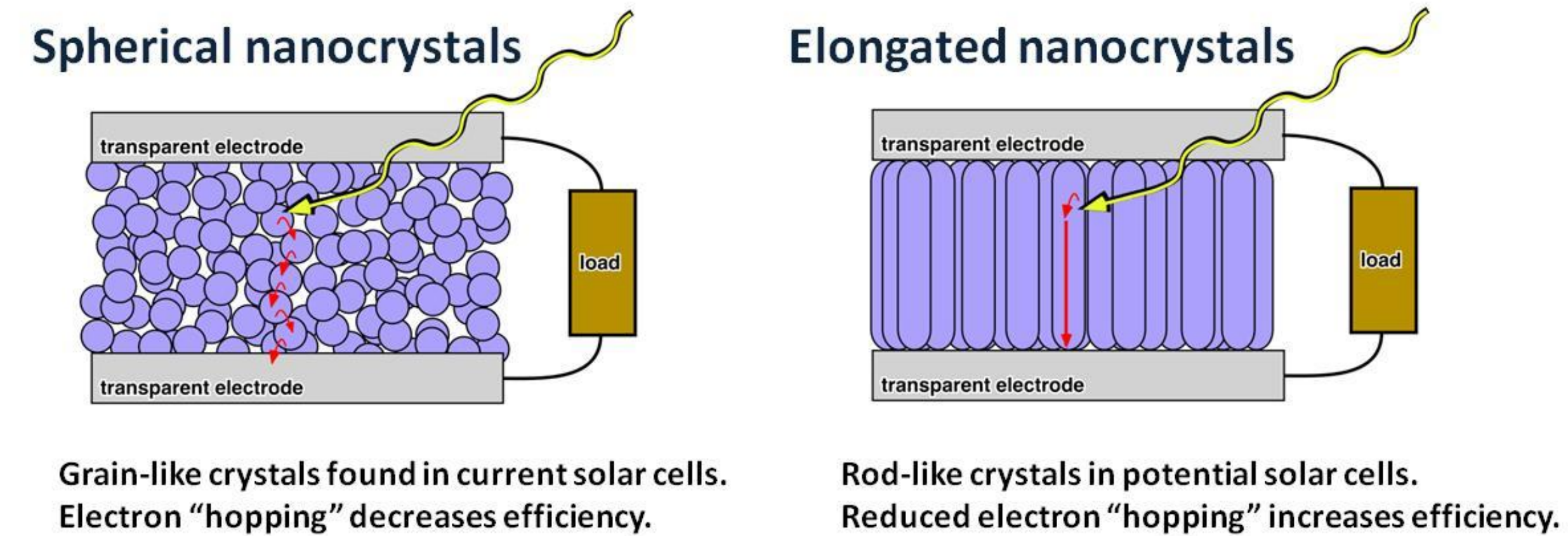


Shape Control of Zinc Oxide Crystals with Succinate Derivatives

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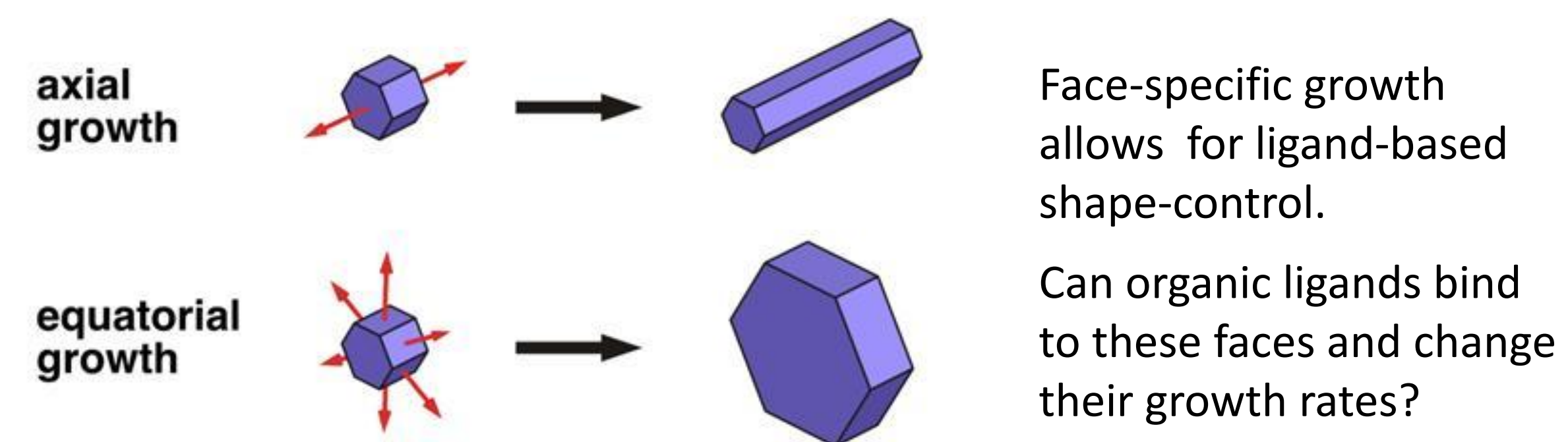
Motivation



Control of crystal shape can enable new semiconducting materials for photovoltaic applications, such as more effective solar cells.

Background

Face-Specific Crystal Growth



Ligands: Succinate & Its Derivatives

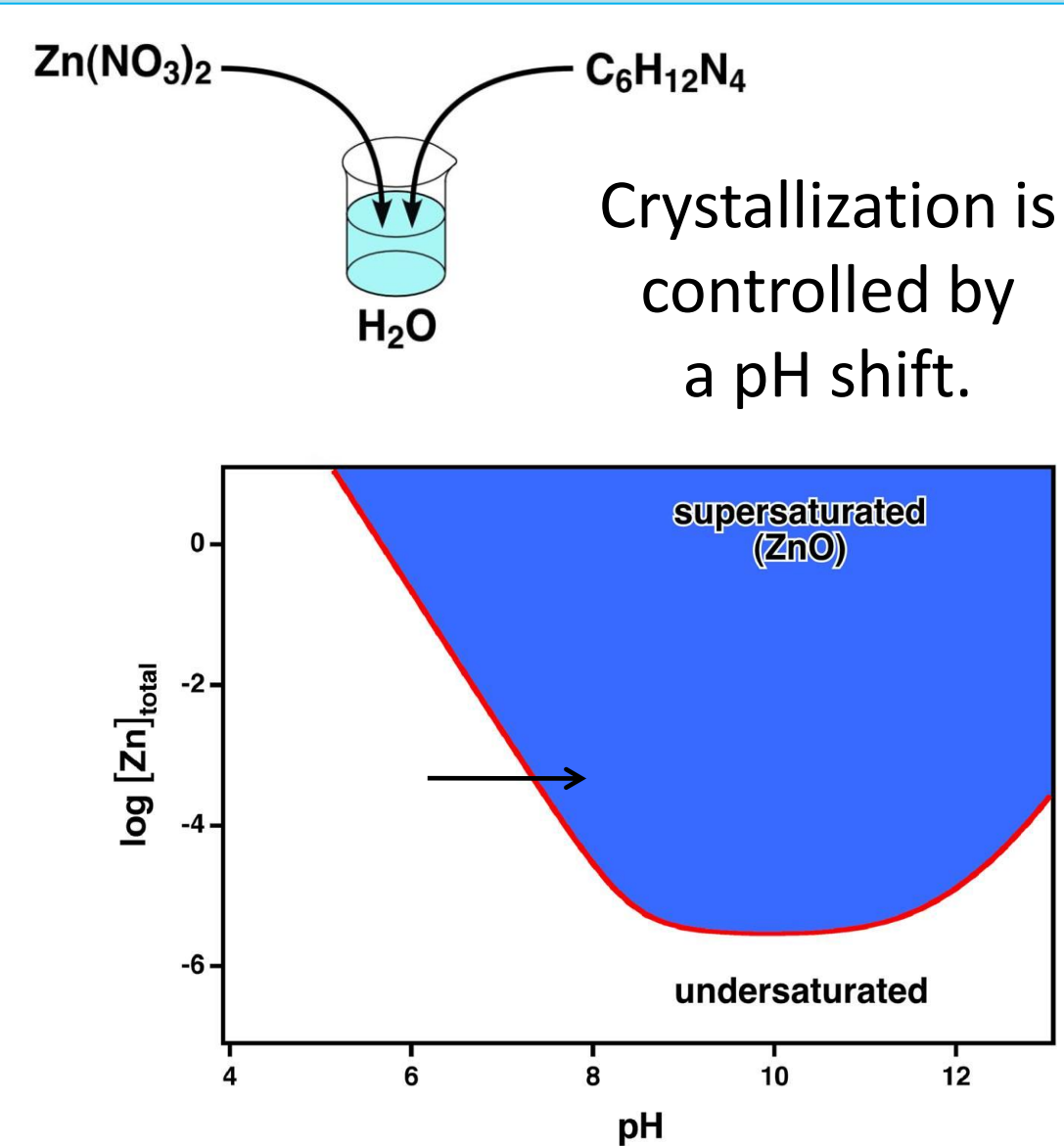


Methods

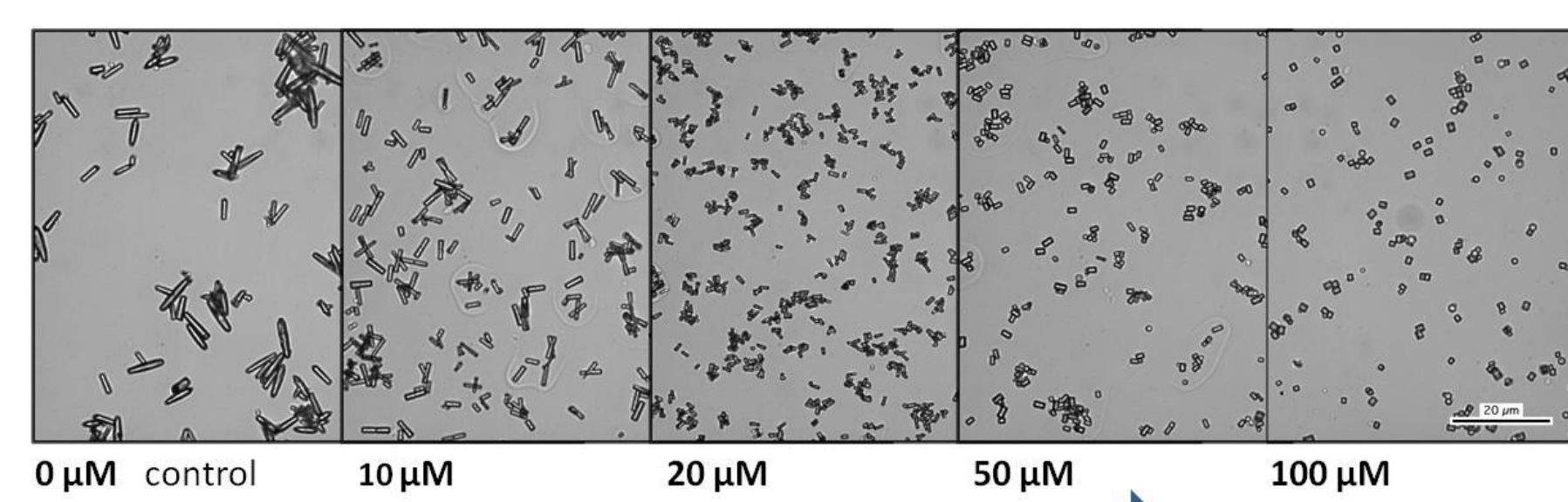
Predictions:

If steric hindrance is responsible for ligand effectiveness, then shape-control activity will be the same for all di-substituted succinates.

If electronic effects are responsible for ligand effectiveness, then shape-control activity will vary based on the substituent.



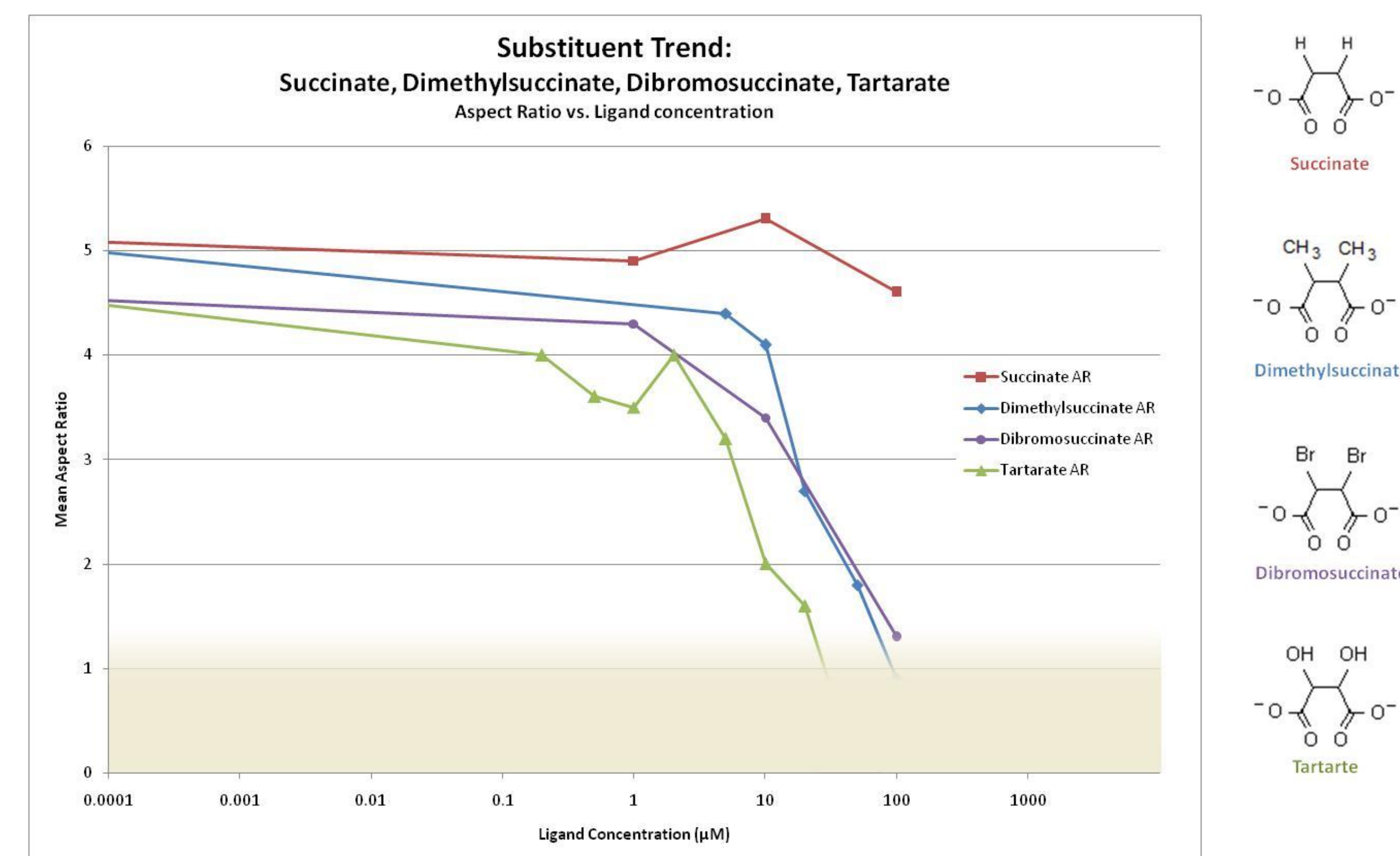
Optical Images: Dimethylsuccinate



Increasing Ligand Concentration
Decreasing Aspect Ratio

Results

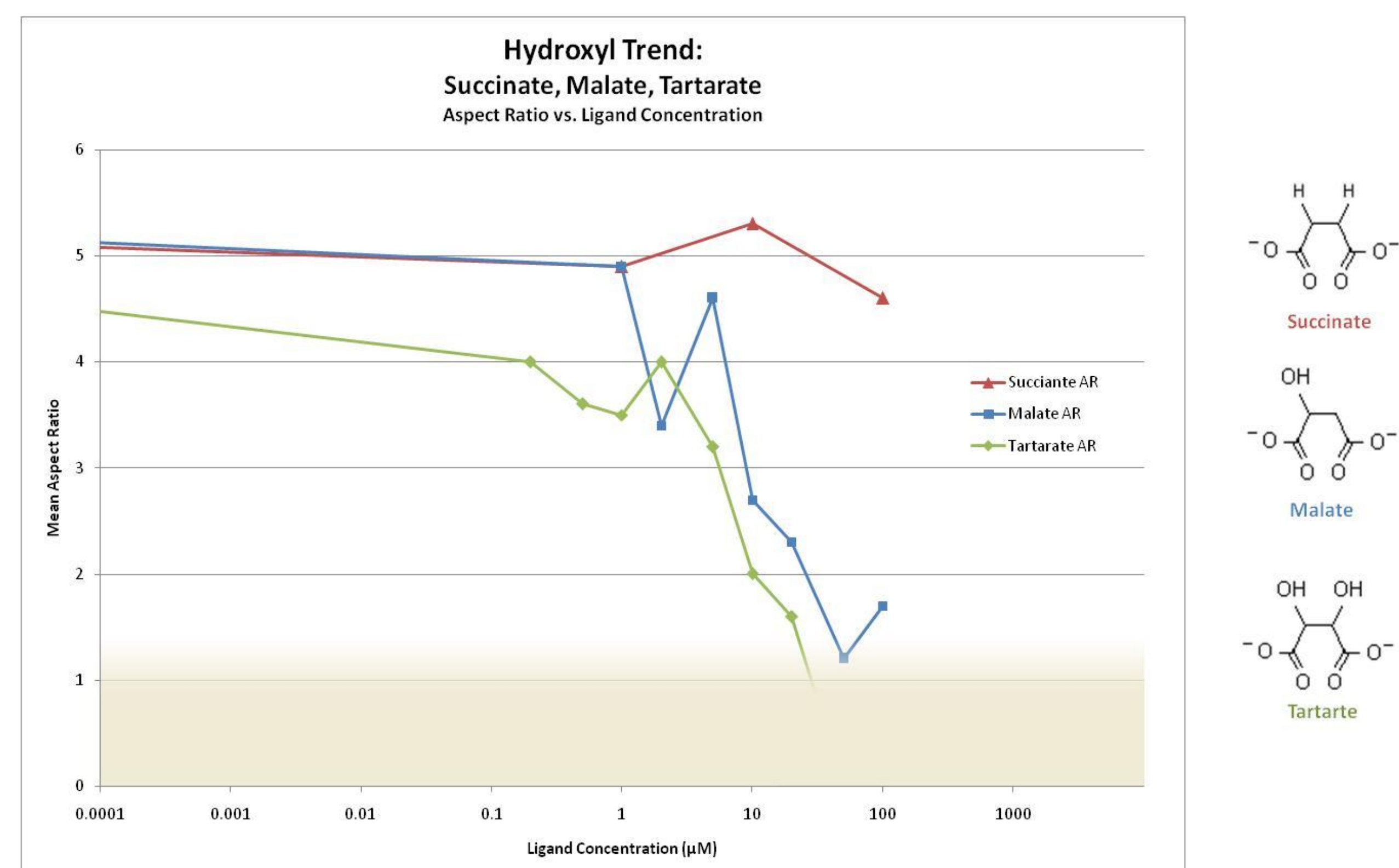
Question: Which substituents enable shape control?



Answer: They all do!

All the di-substituted succinates have similar shape-control activities, implying that it is not the specific substituent, but the general steric hindrance of the substituent which is required for ligand effectiveness.

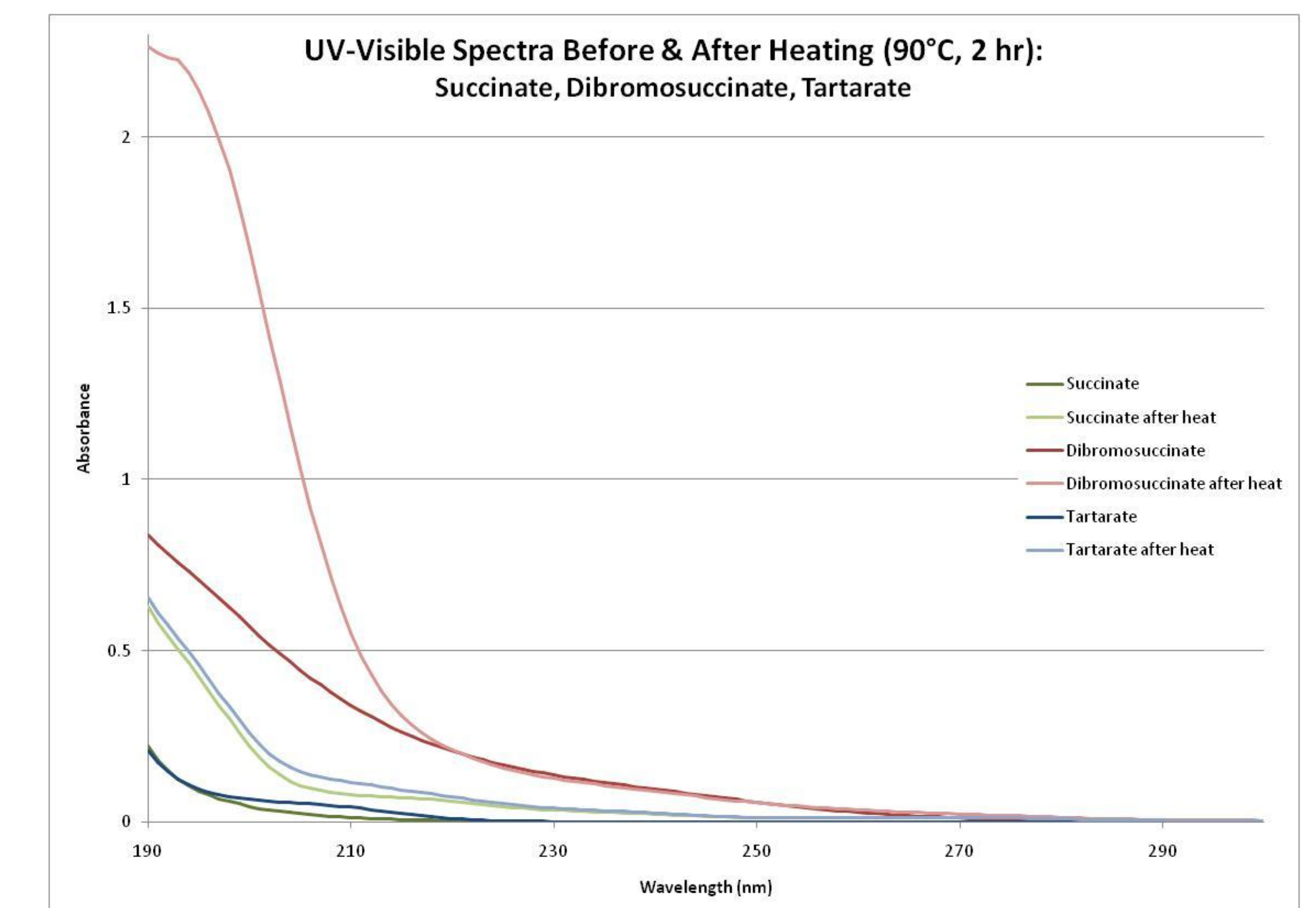
Question: How many substituents are required?



Answer: One is enough, but two are better.

Malate (one backbone substitution) is more effective than succinate, but less effective than tartarate (two substitutions).

Question: Do ligands hydrolyze during heating?



Answer: Yes, all ligand spectra were altered.

But the products do not appear to be responsible for shape control since tartarate and succinate have similar spectra, yet exhibit different shape control activities.

Conclusions

Different di-substitutes on the succinate bridge did not affect the threshold concentration, implying that subtle electronic effects do not determine shape-control activity.

Increasing the number of substituents on the succinate backbone can increase ligand effectiveness.

Ligand uv-vis spectra were altered by reaction-condition heating, but these products do not appear to be active in shape-control, as illustrated by tartarate and succinate.

Further Study

- Examine additional trends in ligand structure.
- Identify products of ligand hydrolysis.
- Time-dependent study of crystal growth.
- Rate and amount of zinc depletion during reaction.
- Determine manner of ligand binding:
 - on crystal surface, or incorporated into crystal structure

Acknowledgments

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