



Alvacat

Synthesis of Ag Shell Catalysts by Incipient Wetness Impregnation

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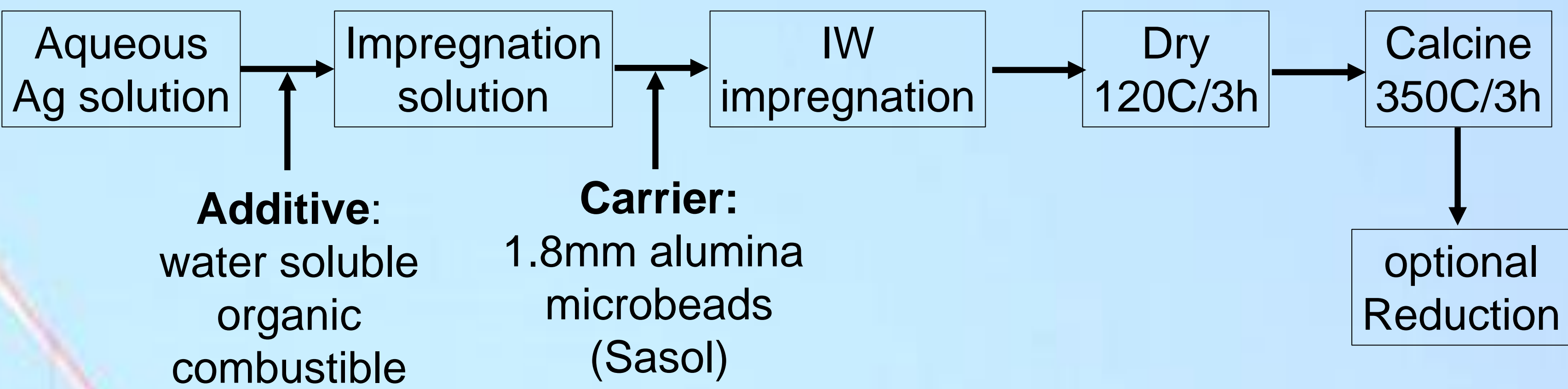
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Company Profile

- Contract research
- Heterogeneous catalysis, Materials science
- Renewables
- Environmental catalysis
- Hydrogen storage catalysis
- Energy storage, Battery materials
- Custom catalyst and support development
- Lab scale, bench scale and scale up
- Catalyst carrier and solution inventory
- High throughput synthesis and screening
- Partnered with tollers for scaleup, piloting, manufacturing and metal recycling

Novel & Scalable Ag Shell Formation Recipes

Single-step wet-chemical impregnation to incipient wetness



- Tunable shell thickness by selection & concentration of additive
- No metal leaching due to incipient wetness impregnation protocol
- No time-consuming wash step

Core-Shell Catalysts

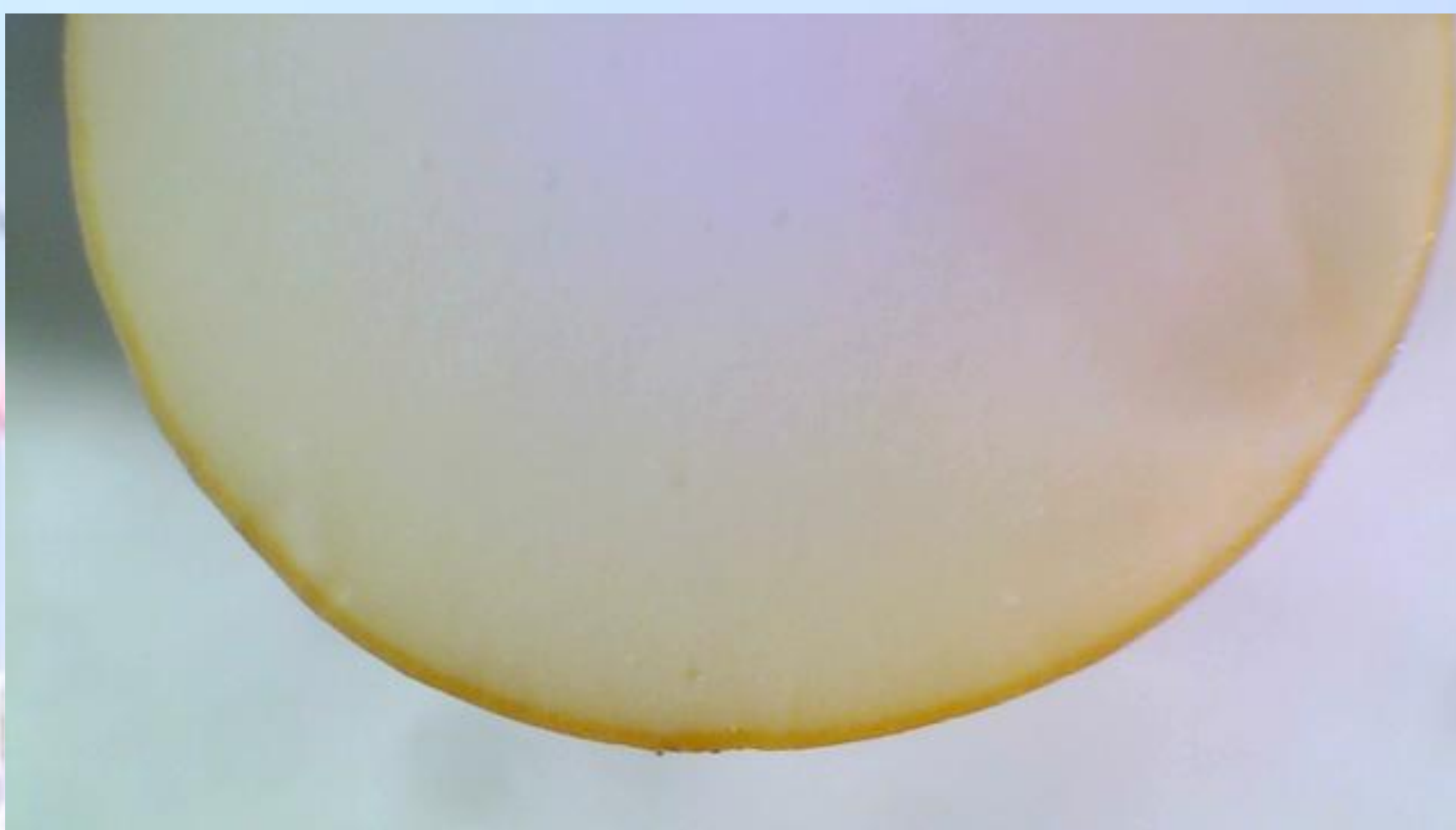
- Widely used for commercial purposes
- Overcome mass transport limitations
- Enhance selectivity
- **Experimental** space for recipe development:
 - Ag precursor selection
 - Chloride-free
 - Thermally decomposable
 - Additives to aq. Ag solution
 - solubilizer
 - dispersant
 - wetting agent
 - Support variation
 - Ceramic & Carbon

Ag Shells on 1.8mm gamma alumina microbeads

Optical micrographs of cross sections post forming gas reduction:



broad Ag shell

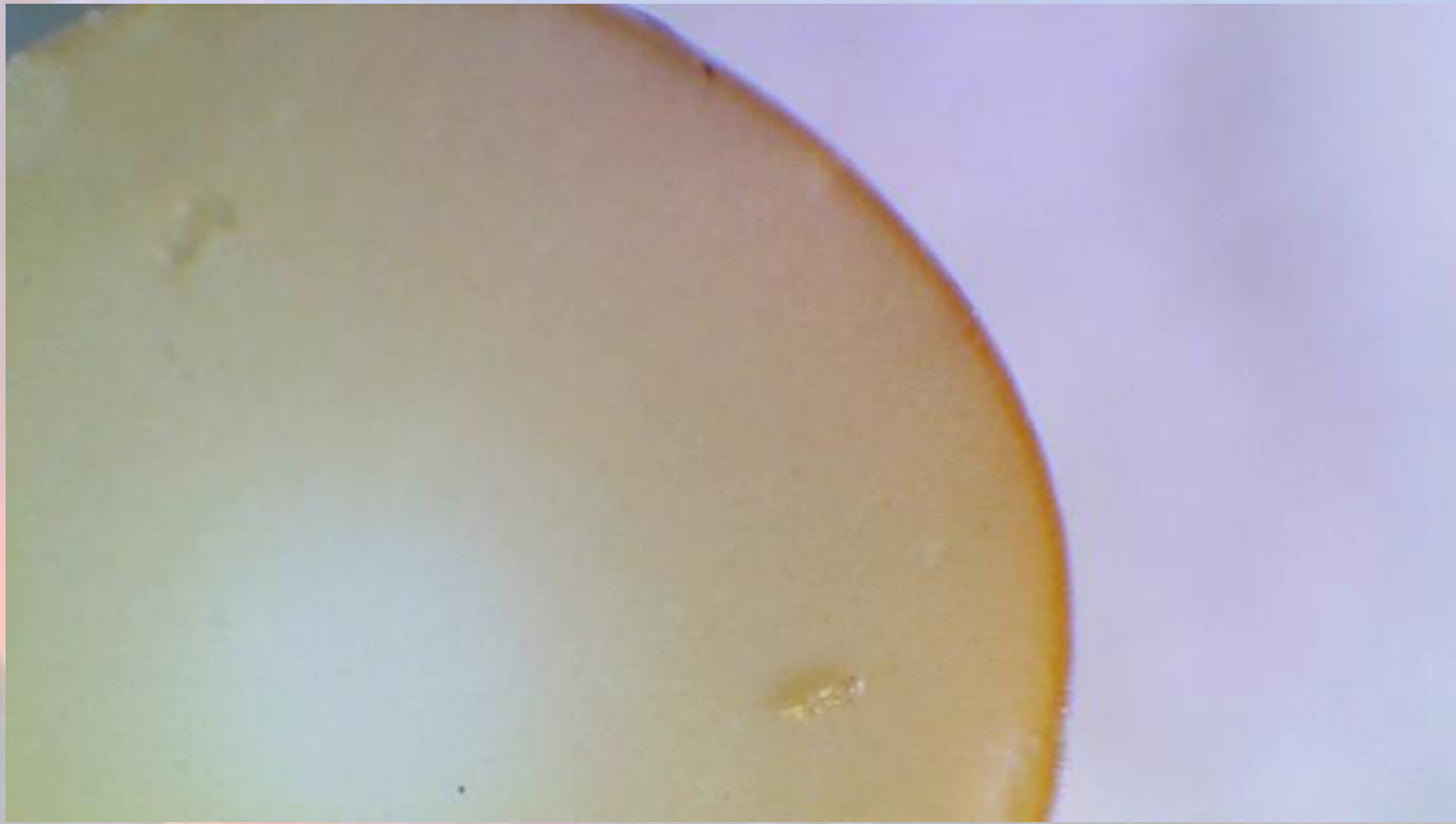
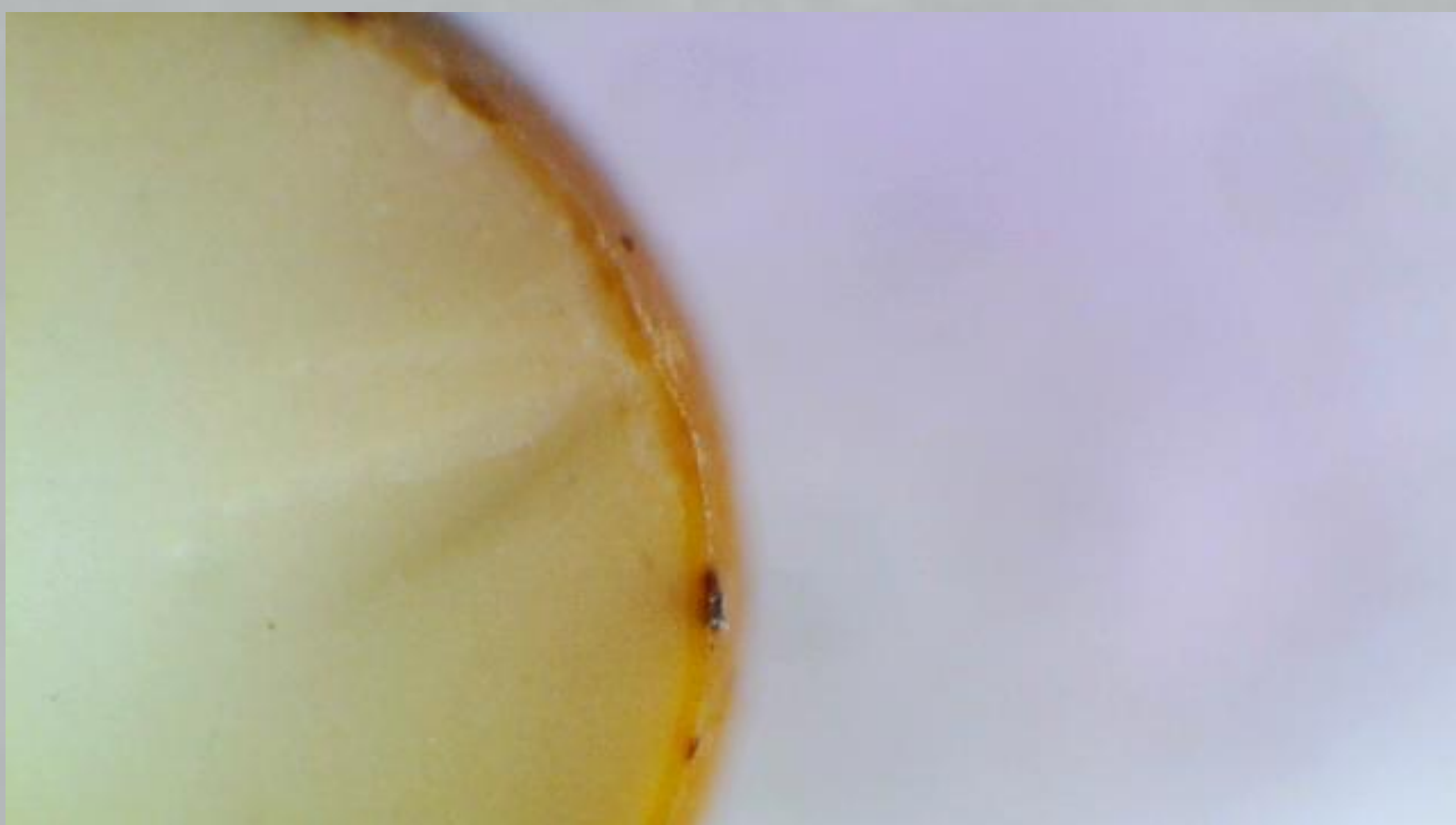


ultra thin Ag shell

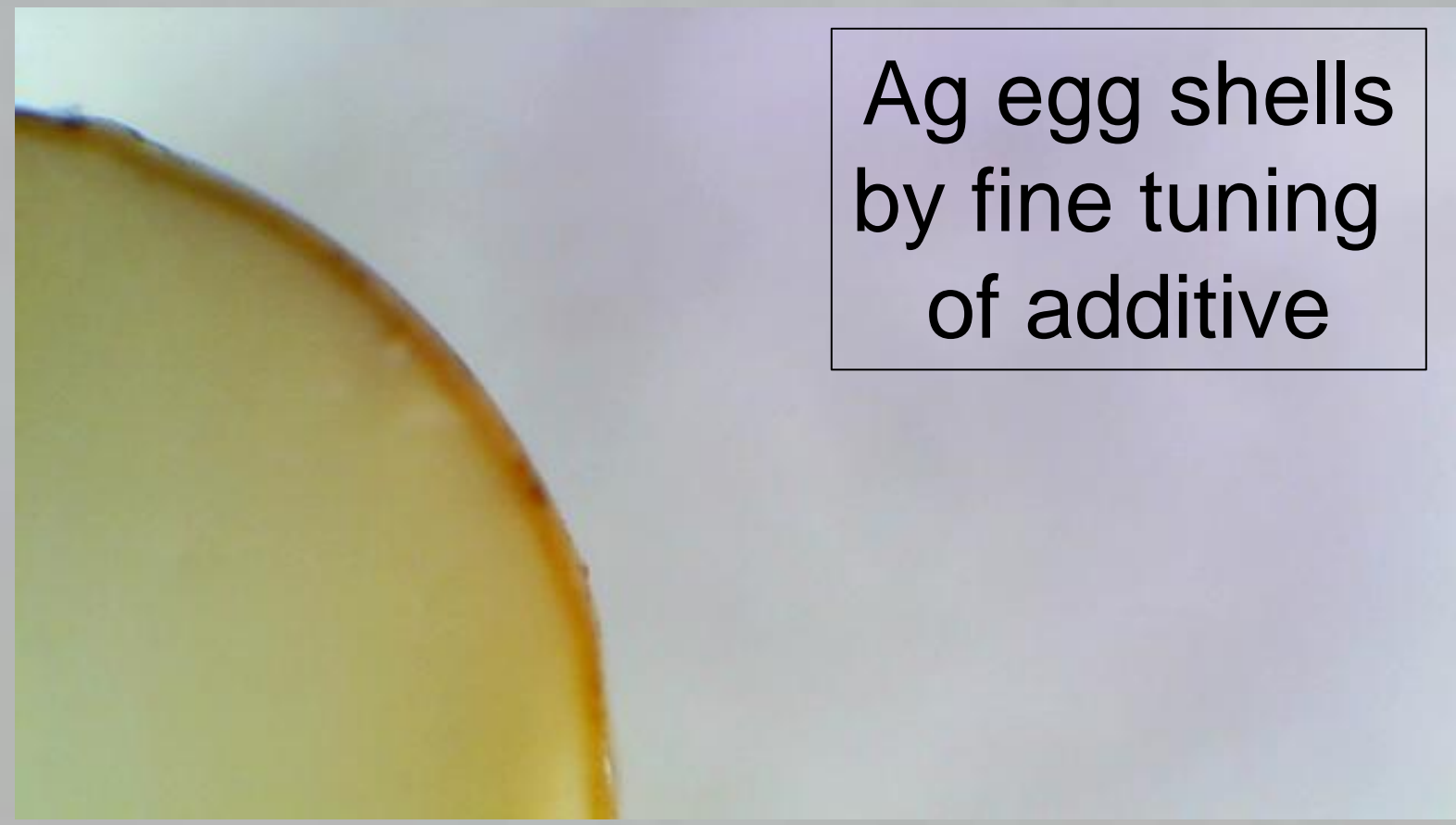
Variation of Additive

Ag Shells on Sasol 1.8mm gamma alumina microbeads

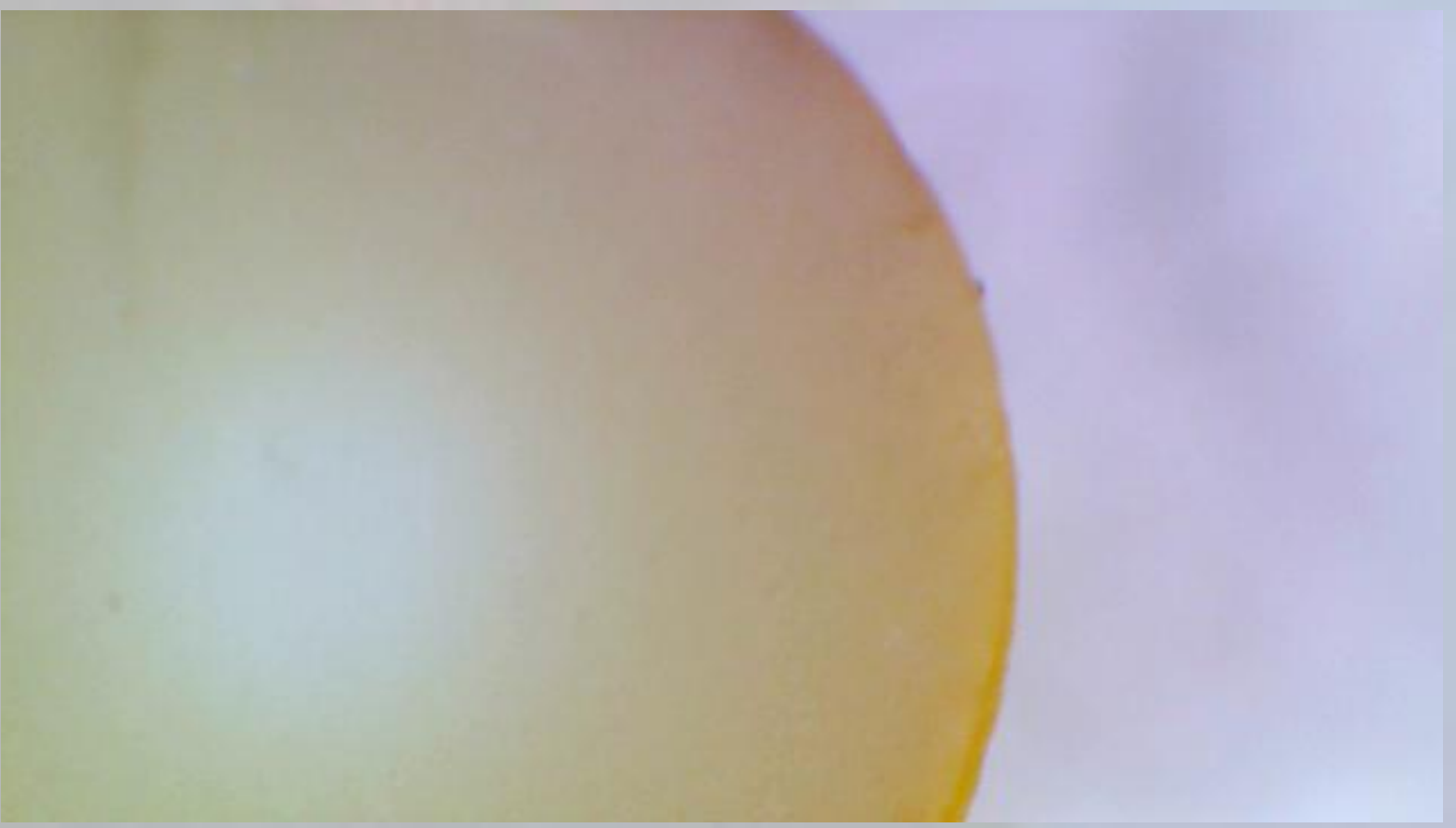
1 wt% Ag loading



Ag egg shell + sub-surface Ag



Ag egg shells
by fine tuning
of additive



Ag gradient

Conclusions

Novel Synthetic Recipes for Core-Shell Catalysts

- Single step wet chemical impregnation
- Adjustable shell thickness
- High plant productivity
 - de-bottlenecking wash and reduction steps
- Distinguishing features from traditional base fix/back diffusion/chloride wash recipe
 - chloride-free metal precursors
 - skip time-consuming wash step
 - no metal leaching
 - no capital investment in spray coaters
- Recipes available for base and precious metals
 - alumina microbeads
 - carbon pellets and extrudates