# *A new method for the development of manufacturing processes for injectable drug product*

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# *(From drugs molecules to products)*

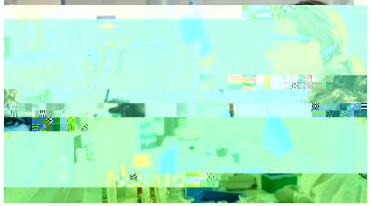
Man-made drugs – small molecules (chemical synthesis) to large molecules (biotechnology)

Aspirin
21 atoms

Hormone
~3000 atoms

Antibody
25,000 atoms

**Production**



Product available in the market

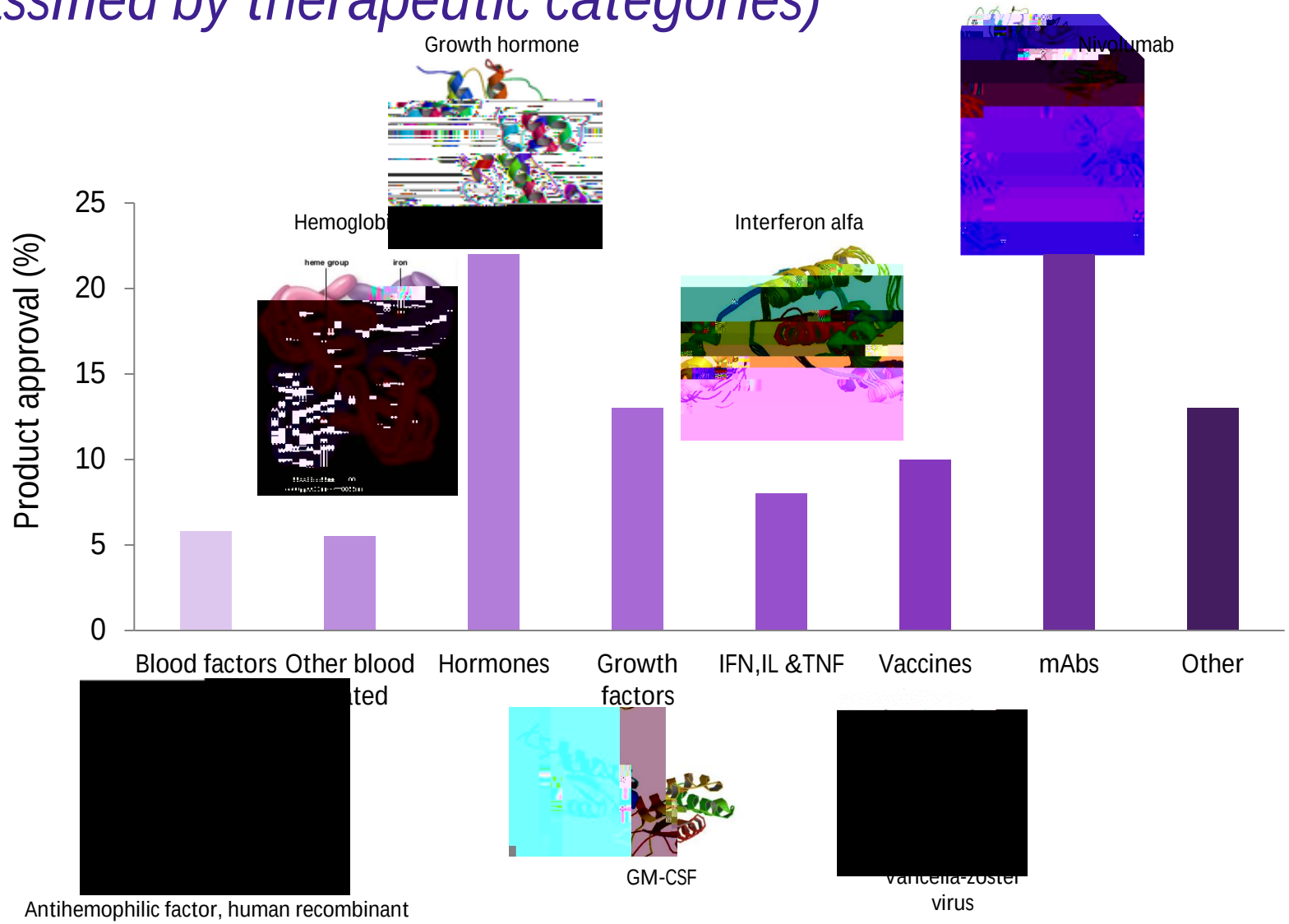
- Quality: Safety & Efficacy

**QC** Pharmacopoeial tests

Formulation development

- Drug products (i.e. dosage form: tablets, injections) etc.
- Healthcare and cosmetics product (i.e. nutrition)

# *(classified by therapeutic categories)*



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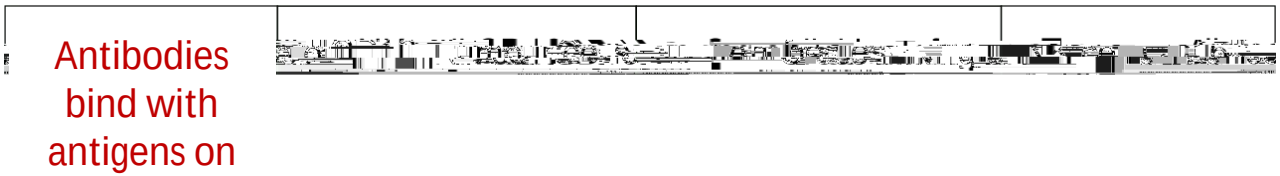
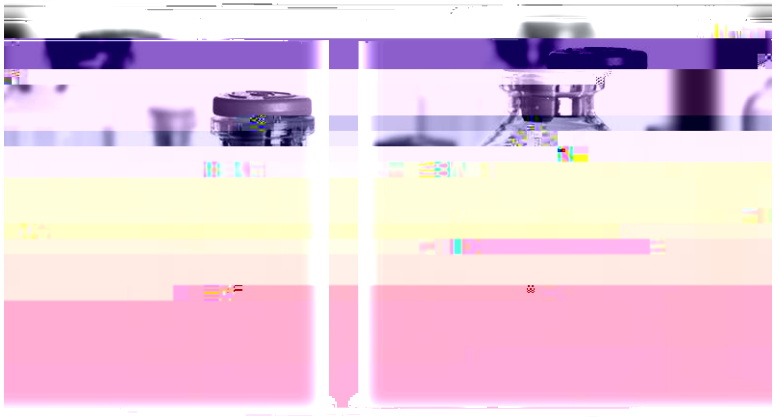
# E

- A monospecific immunoglobulin
- Medicinal application of mAbs
  - Diagnostic application (i.e. immunoassay, immunoscintigraphy), e.g. Prof.Abdelhamid
  - Therapeutic applications (i.e. Cancer, Transplantation, Immune disease etc.)

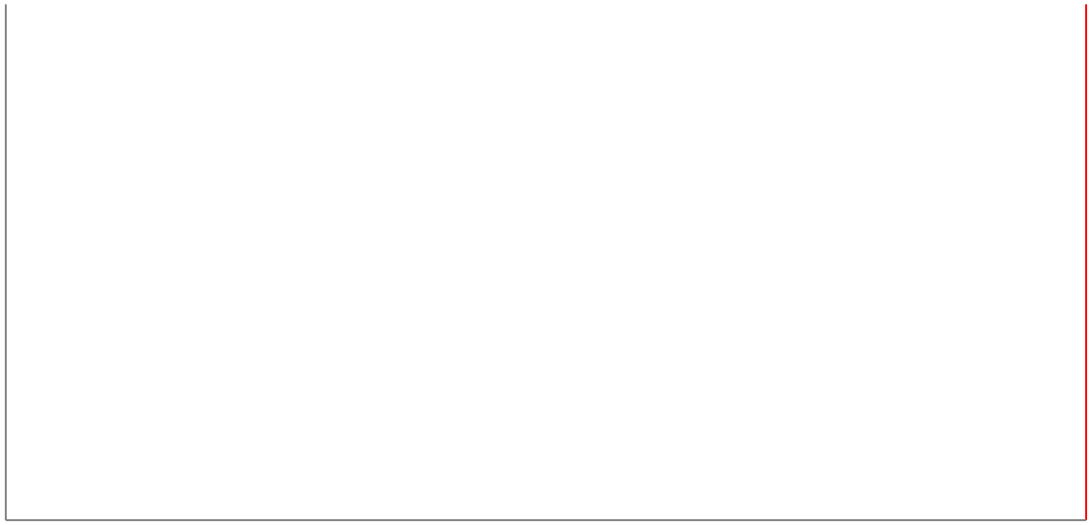


# L



# L

- A technique which dries product at low temperature through sublimation process
- It consists of three main steps : **L** , and



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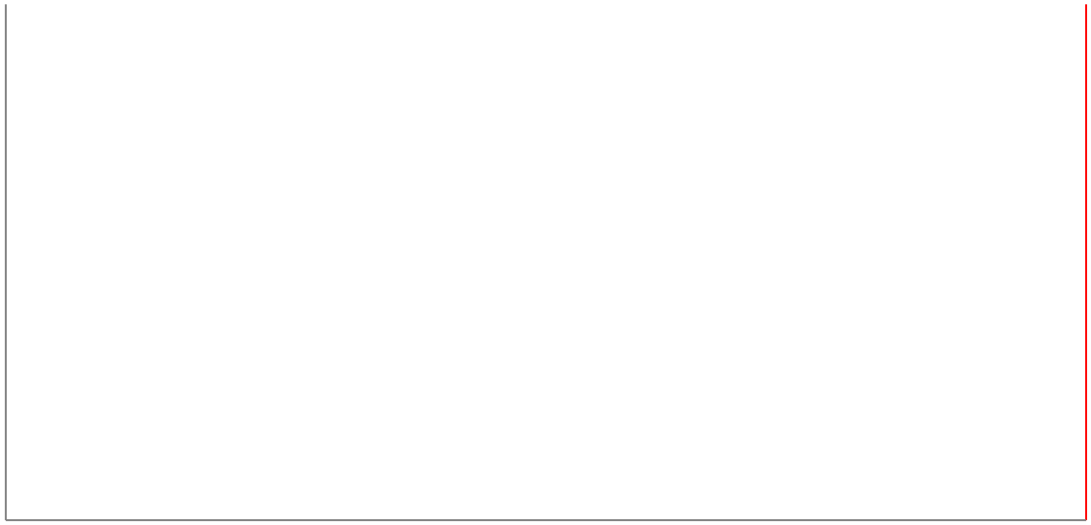

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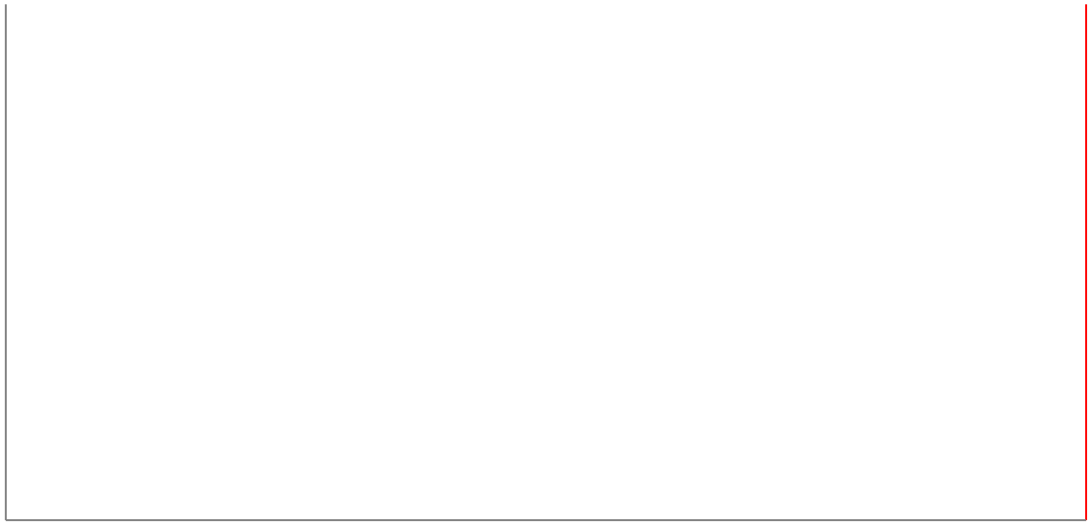

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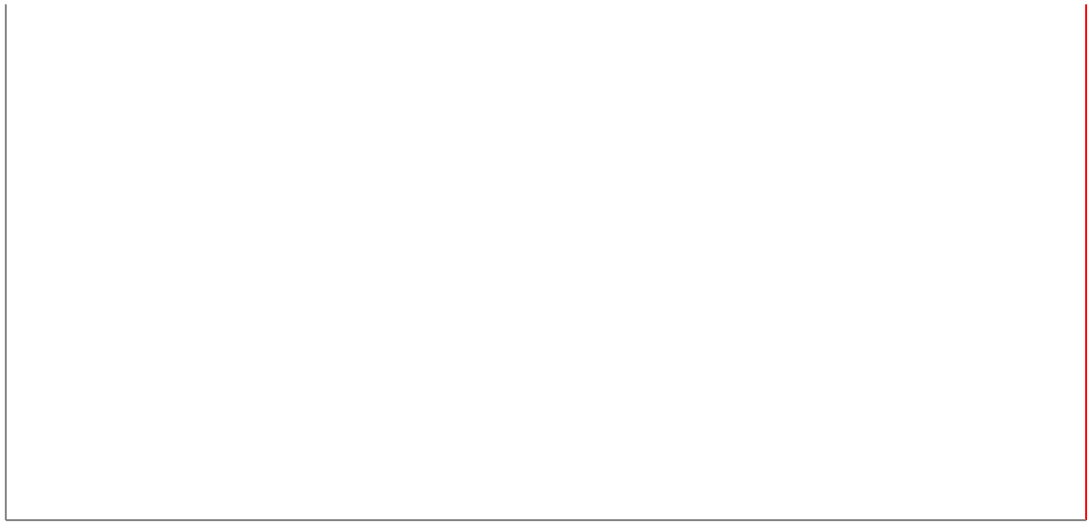

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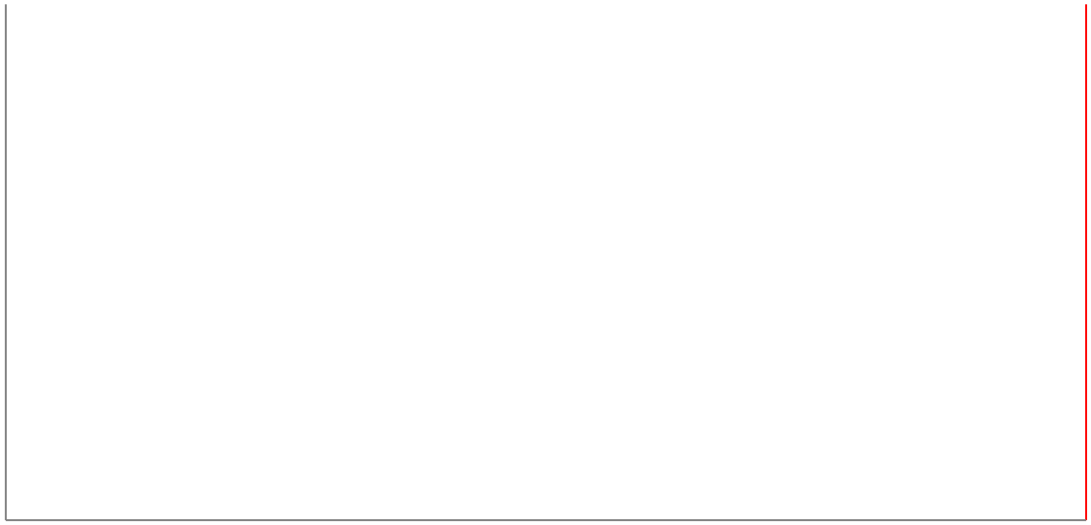

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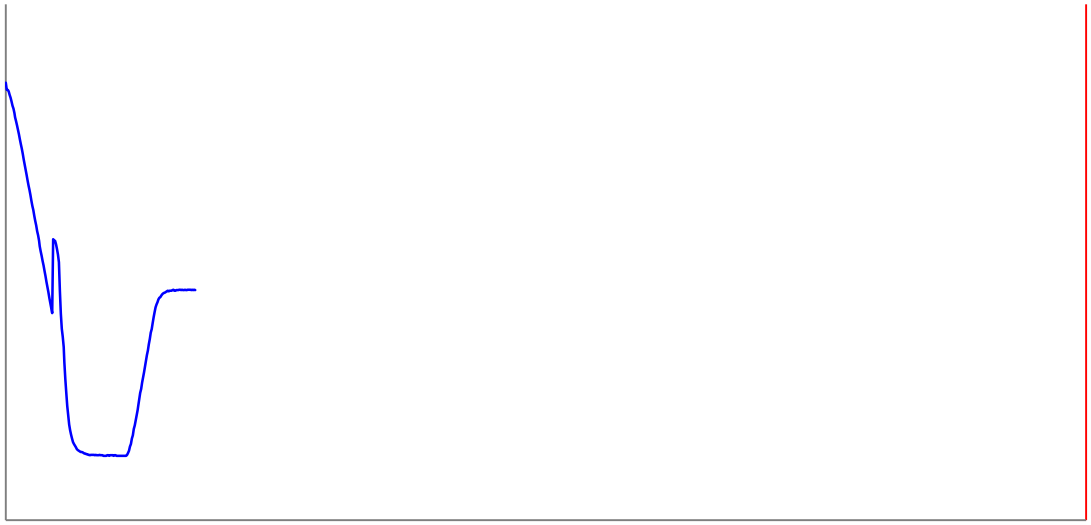
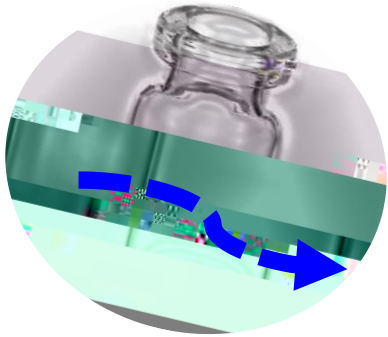


- Impedance spectroscopy characterizes the ability of materials to conduct



# Through Vial Impedance Spectroscopy (TVIS)

*Introduction*

# E

- Through Vial Multi Channel Impedance Analyzer
- Impedance measurement specially optimized for lyophilization experiments (contact method)
- Five sequentially measuring impedance

- An equivalent electrical circuit model is created by combining the circuit elements which includes the solution resistance (  ) and the capacitances of the glass-solution interface (  ) and the solution (  ) in an appropriate configuration of series and parallel elements.

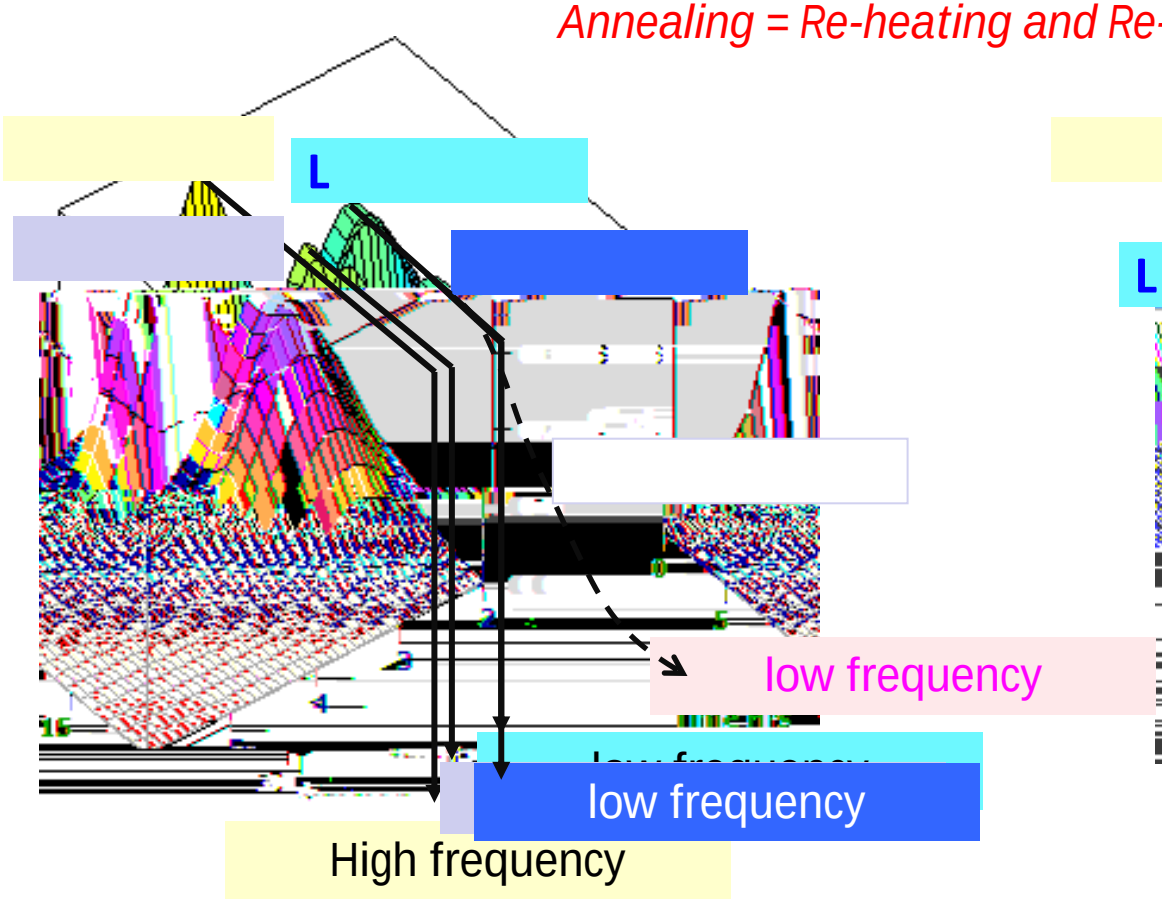
$C_G$ is the capacitance of the glass-solution interface,

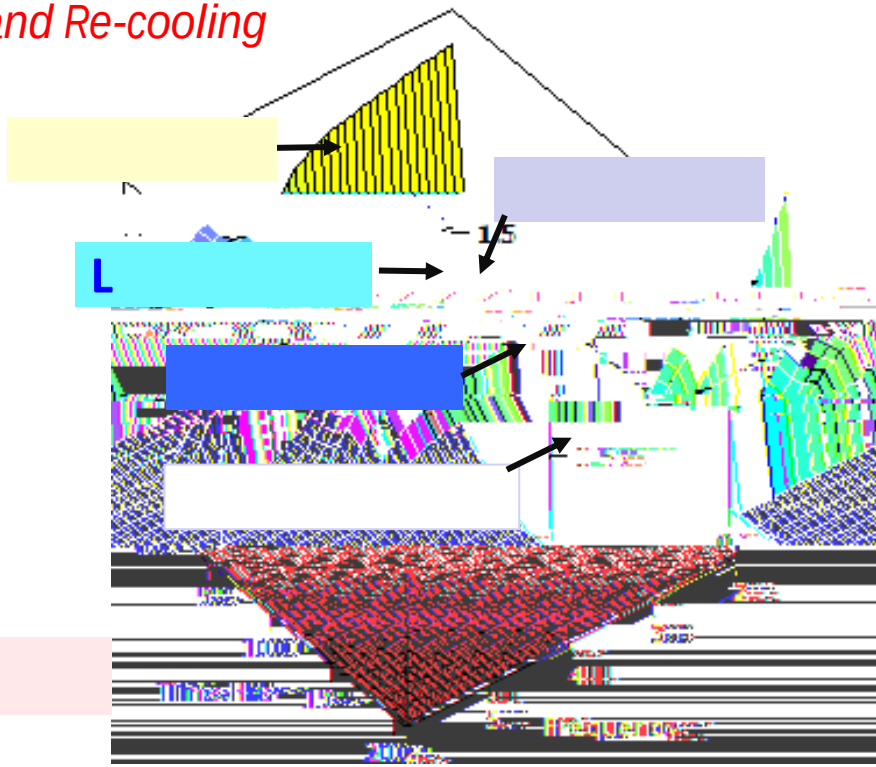
$C_S$

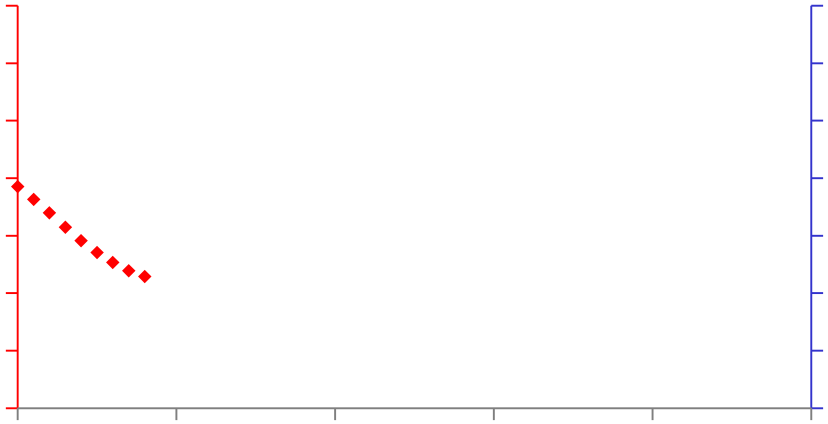
Imaginary Part of Capacitance

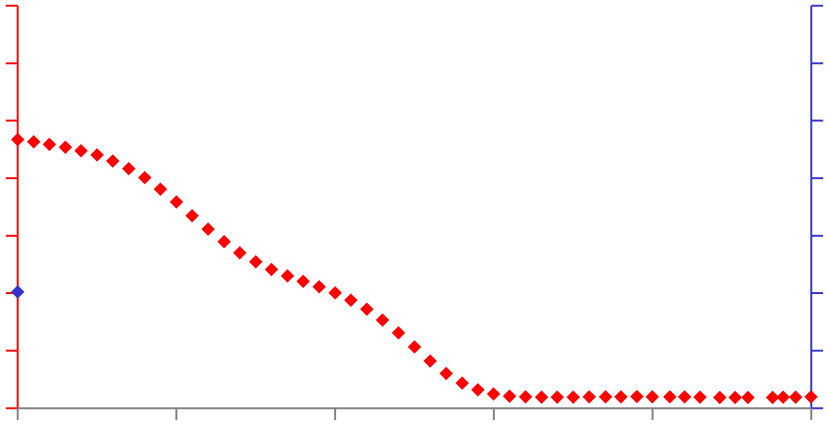
Real Part of Capacitance

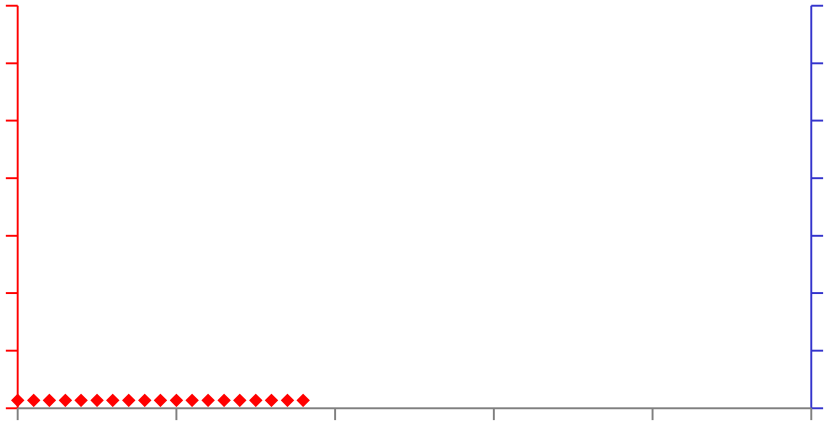
*Annealing = Re-heating and Re-cooling*



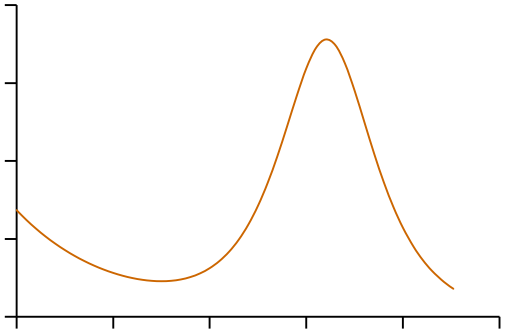



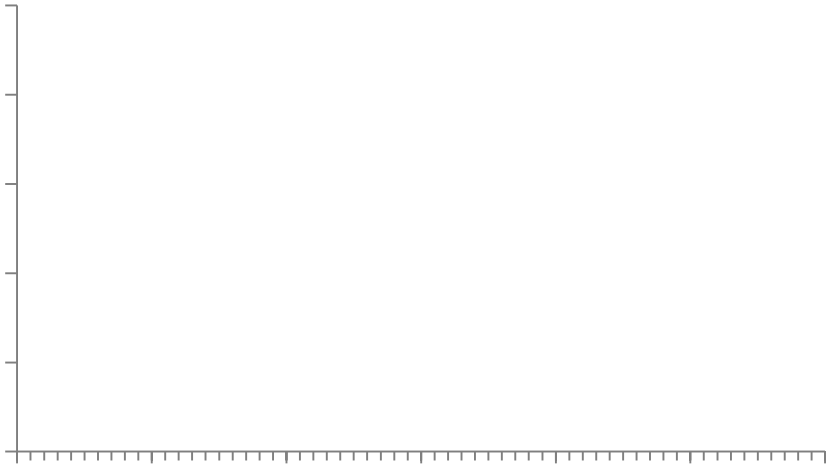






- TVIS measurement relate to both the *electrical resistance* and *electrical capacitance of the vial contents.*





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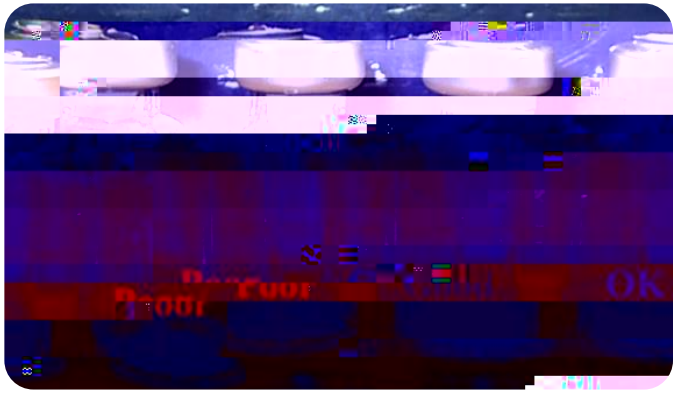
- Temperature calibration of the TVIS parameter ( ) for ice during an additional temperature cycling stage applied to a prediction of ice temperatures during the initial (few hours) of primary drying
- Temperature compensation of TVIS parameter ( ) allows for an accurate estimation of ice mass during primary drying as evidenced by comparable

# L

- Development mapping a drying characteristics from lab scale to production
  - Determination of heat transfer coefficients (  )
  - Determination of dry layer resistance (  ) to predict drying efficiency



- Investigation the molecular dynamic of the unfrozen fraction
  - Monitoring product stability
  - Examine the mechanical strength of the freeze dried product (i.e. collapse behaviour)

- Develop (new) continuous drying technologies