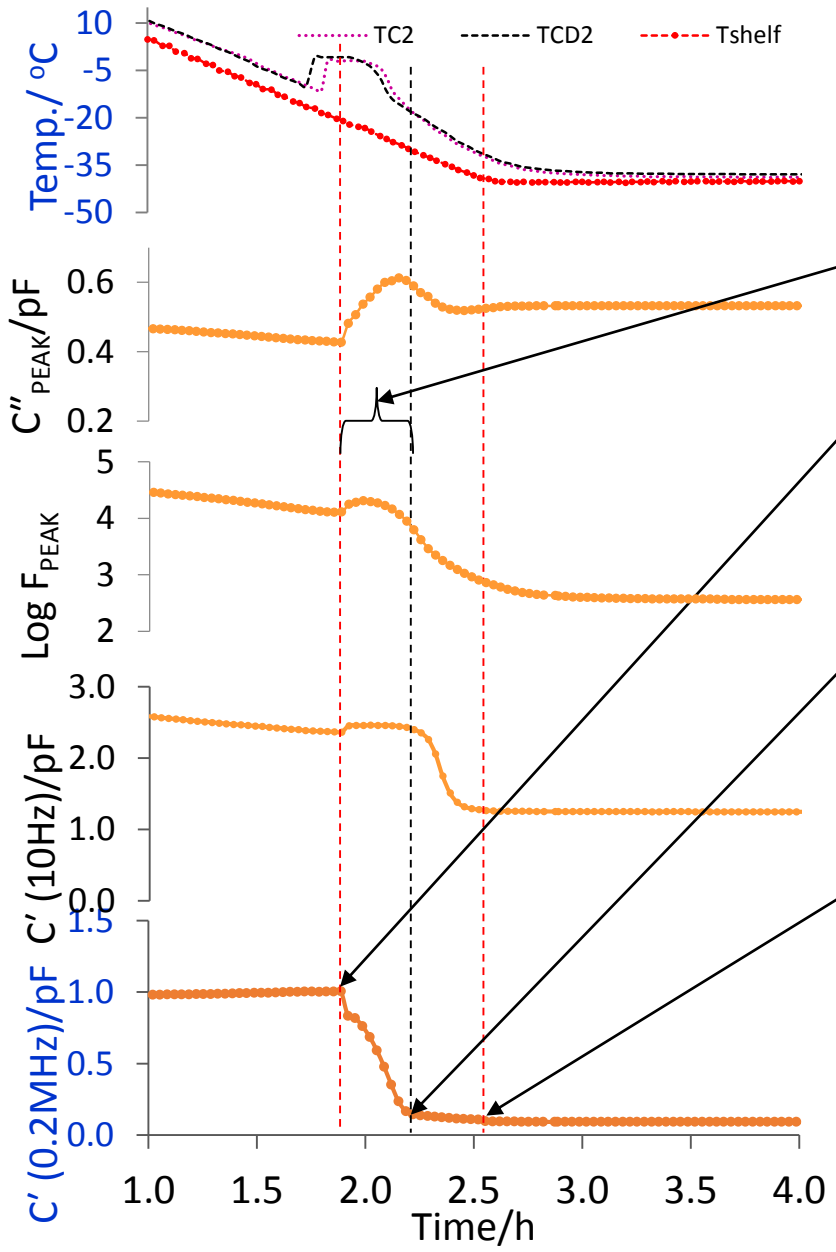
TVIS event identification with temperatures



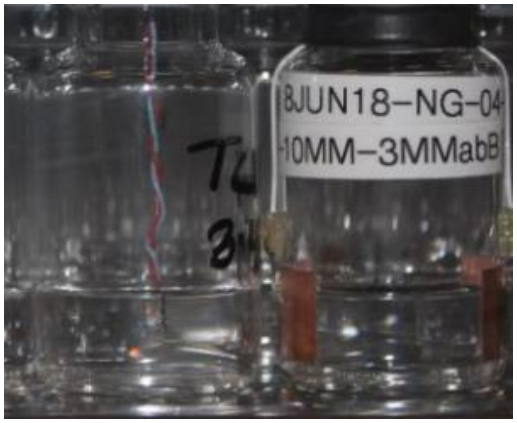
Solidification period

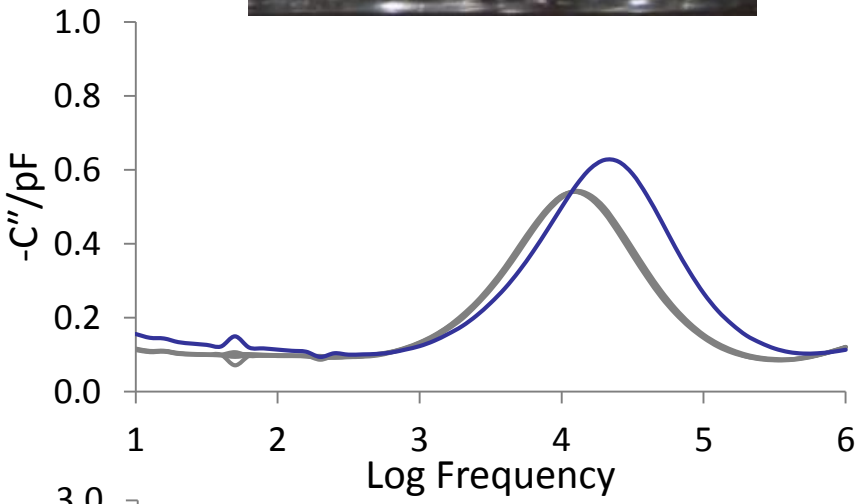
Ice growth onset -13 °C

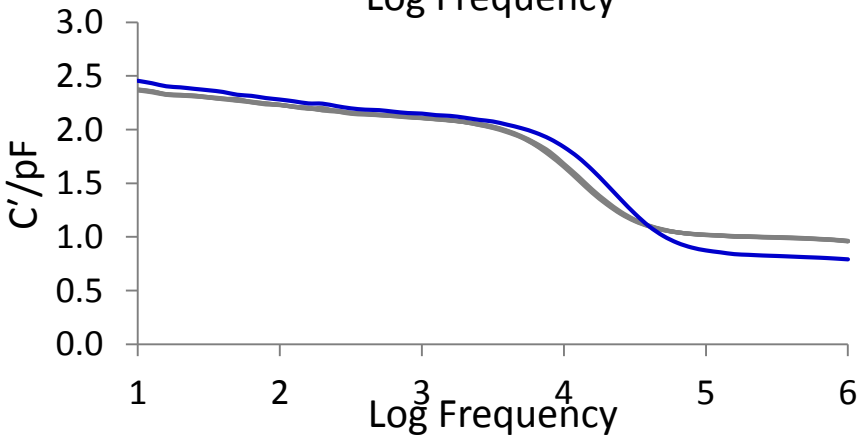
Ice growth end point -18.5 °C

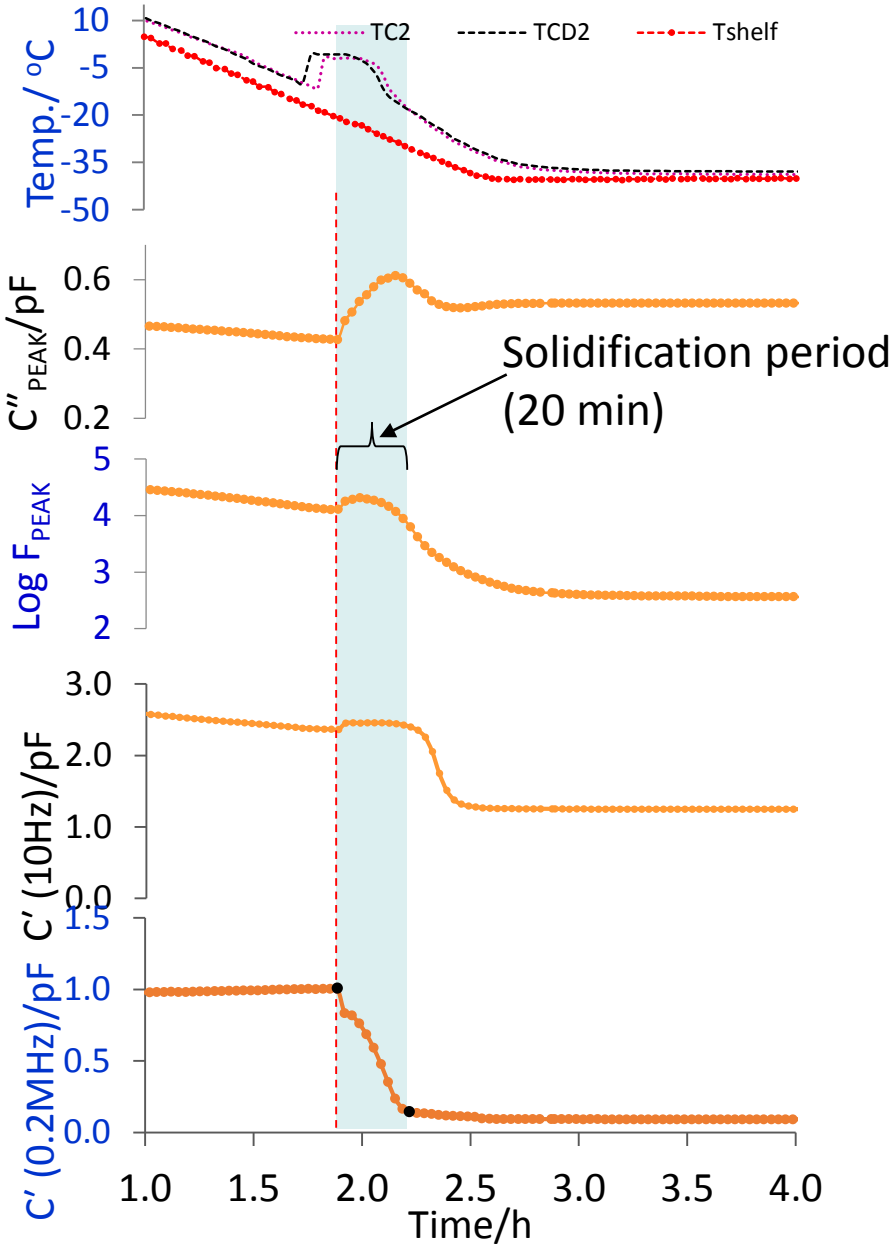
Mannitol crystallization -32 °C

TVIS event identification: nucleation onset

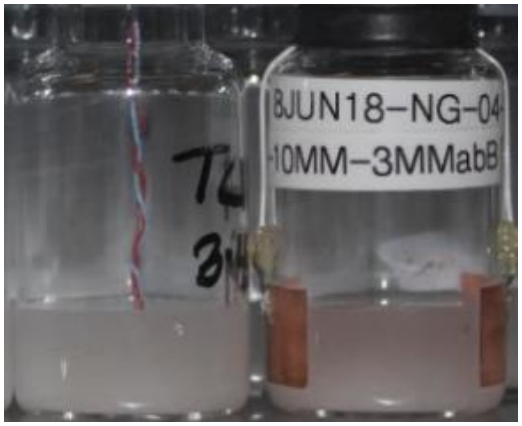


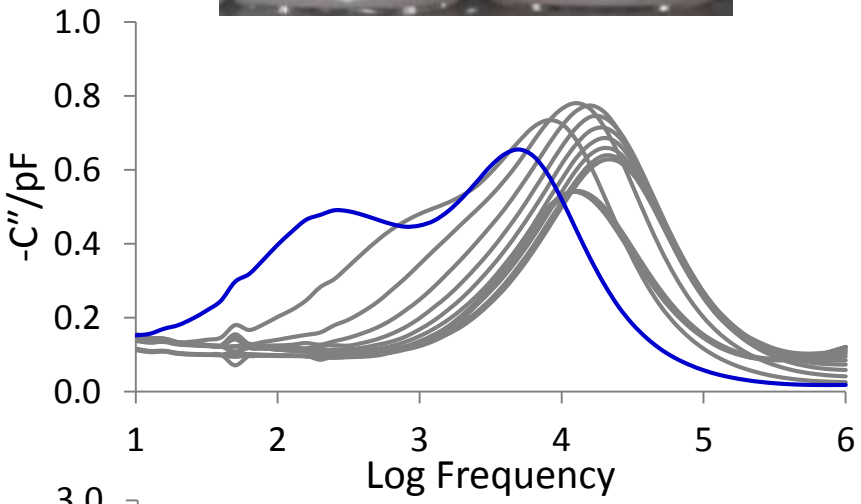


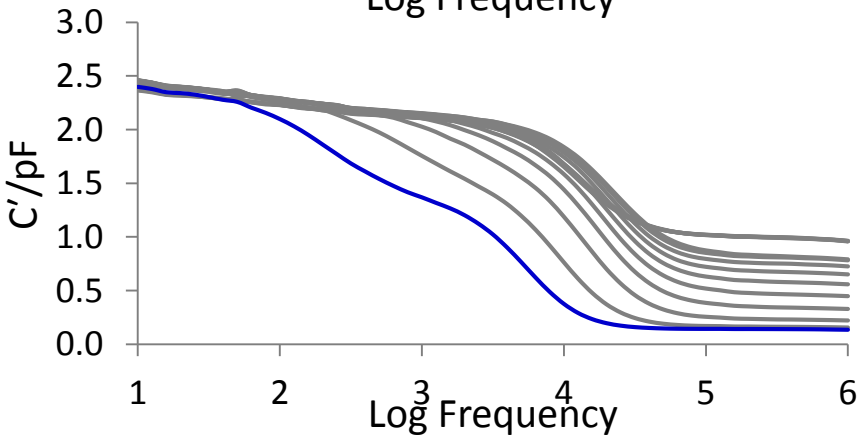


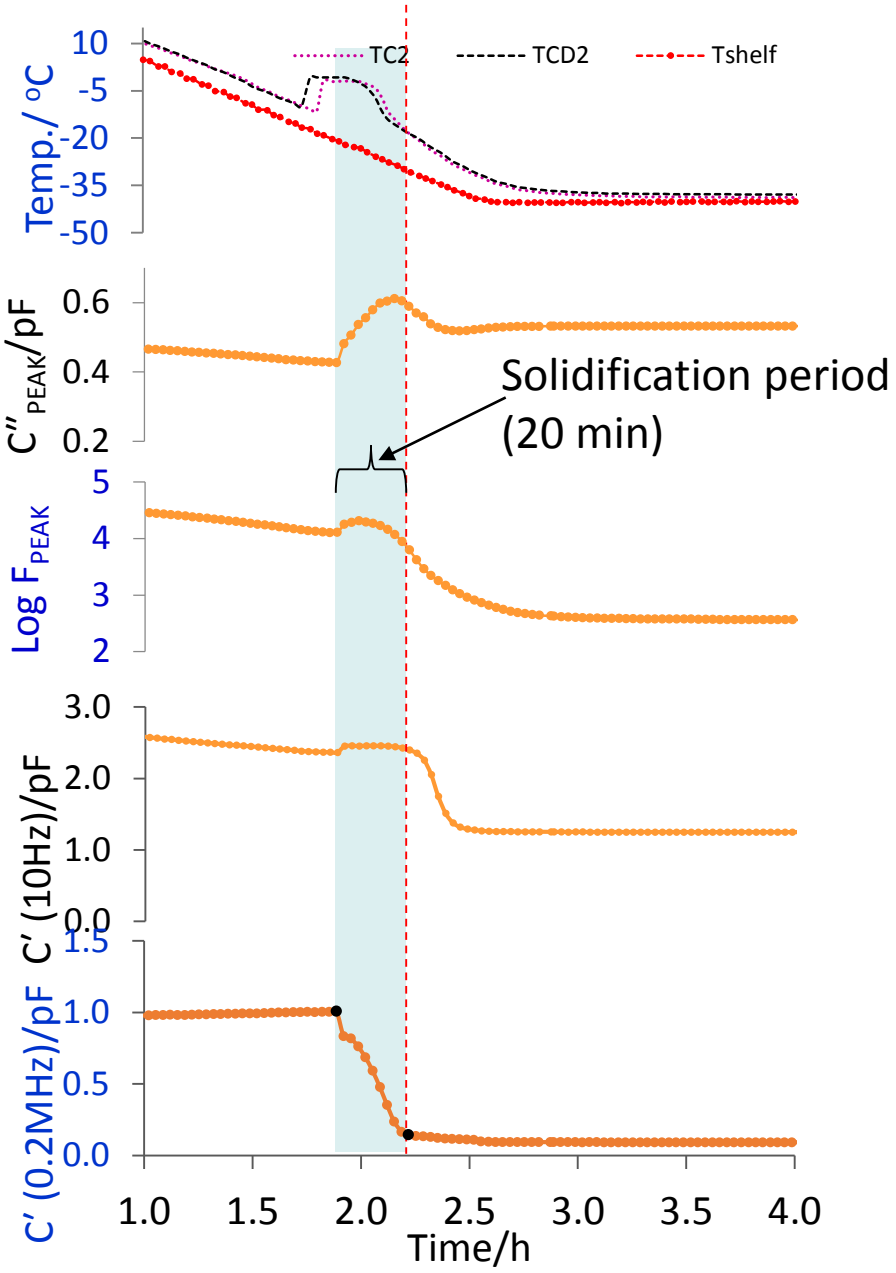


TVIS event identification: solidification endpoint









TVIS event identification: event summary

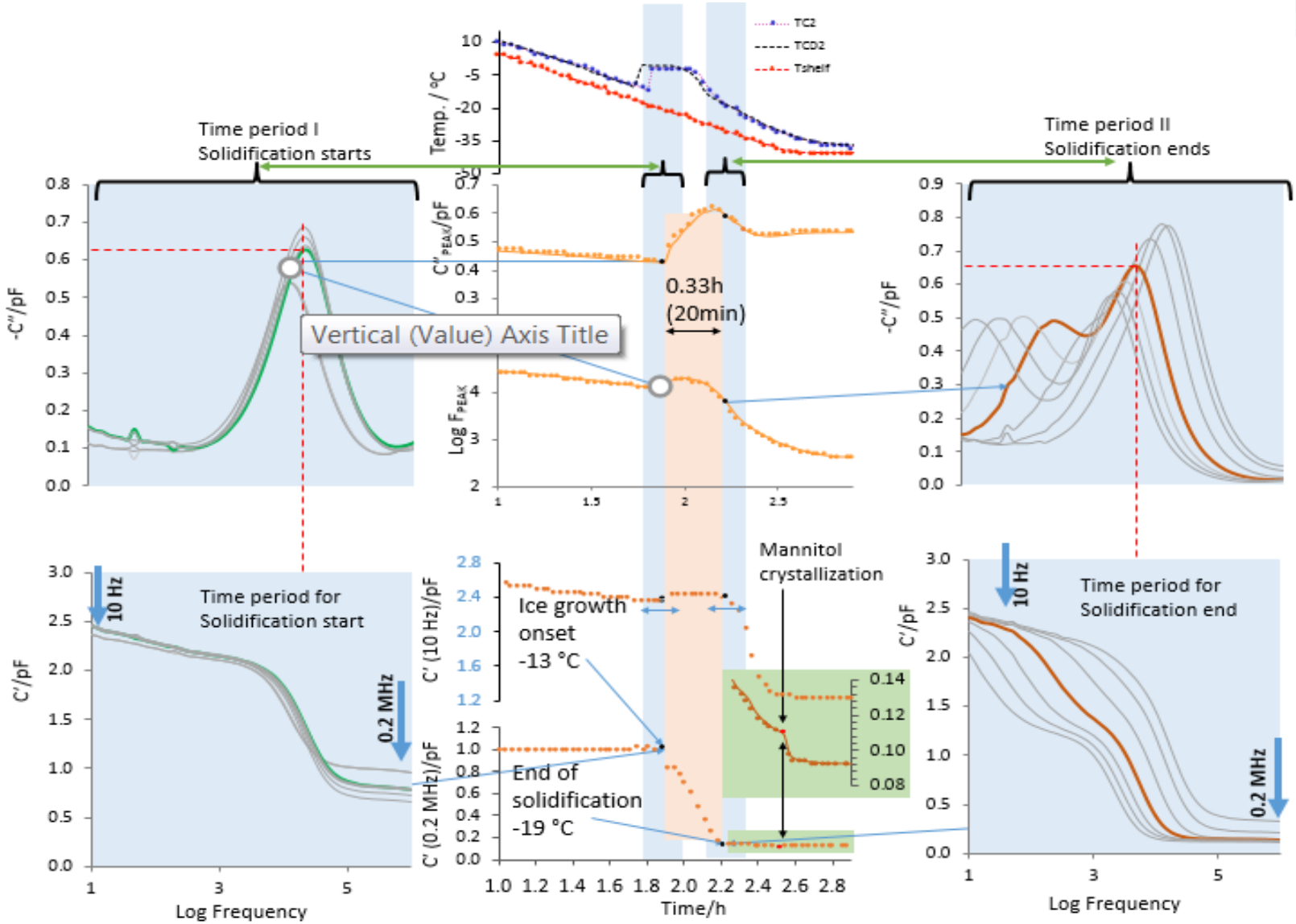
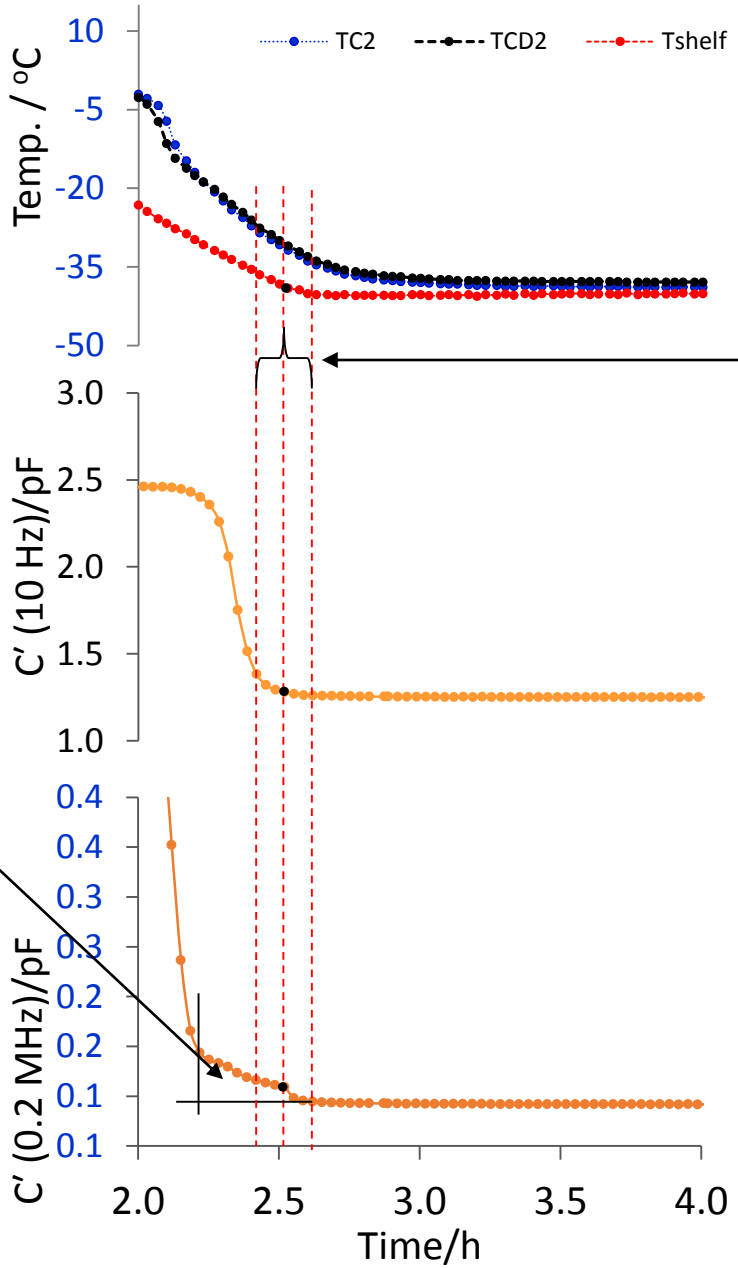


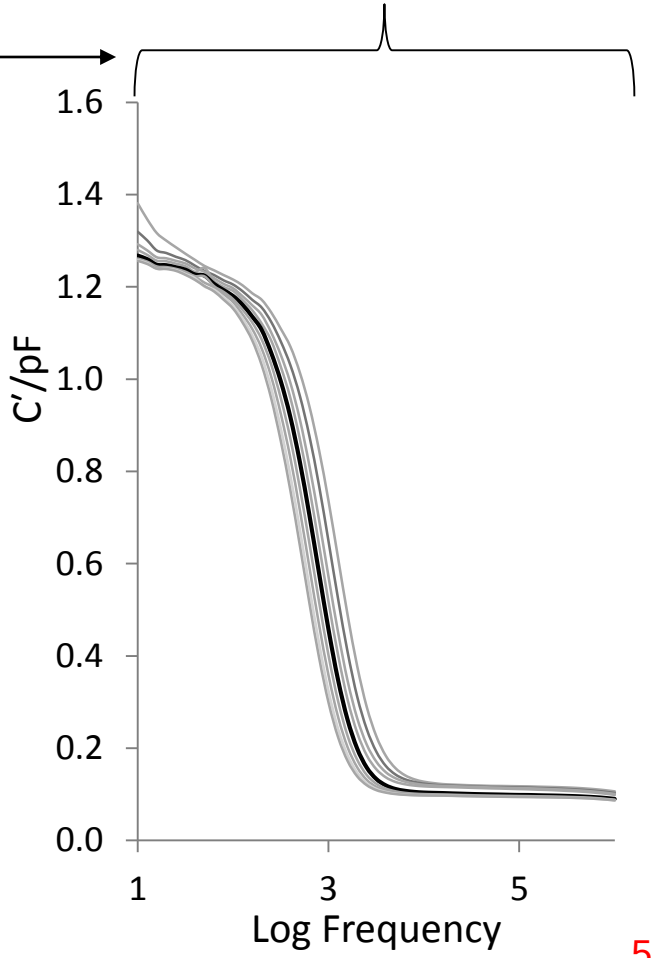
Fig.3 Log F_{PEAK} and C''_{PEAK} with respect to time depict the events that happened 6 min before and after ice growth onset and during the solidification end point. Spectra around the two major events in the freezing process could assist for more understanding of the happenings during freezing process. In addition, capacitance spectra at lower frequency (10 Hz) and higher frequency (0.2 MHz) show the temperature dependence in the lower frequencies.

FREEZING STEP: Mannitol crystallization

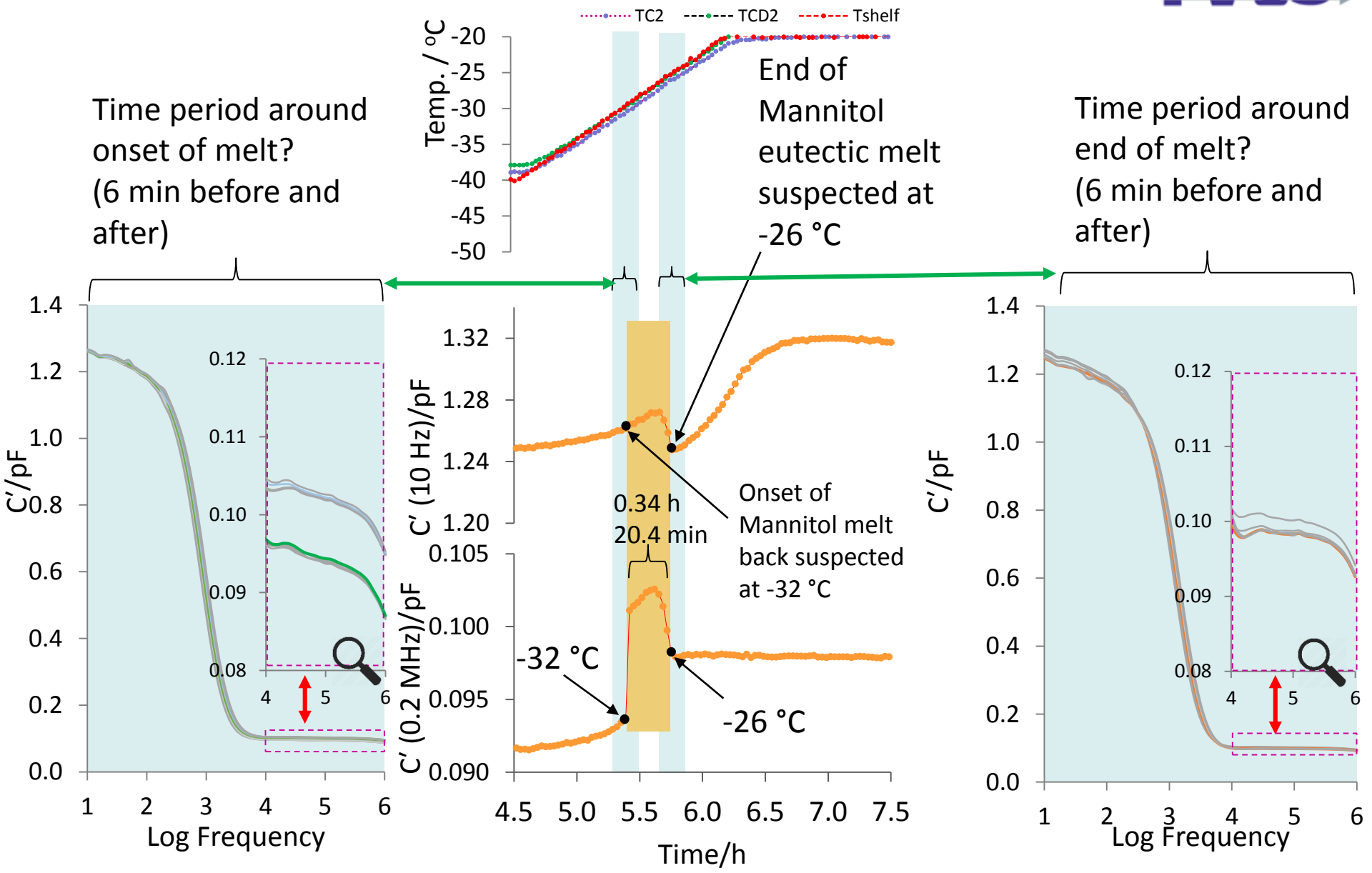


Gradient due to unfrozen water

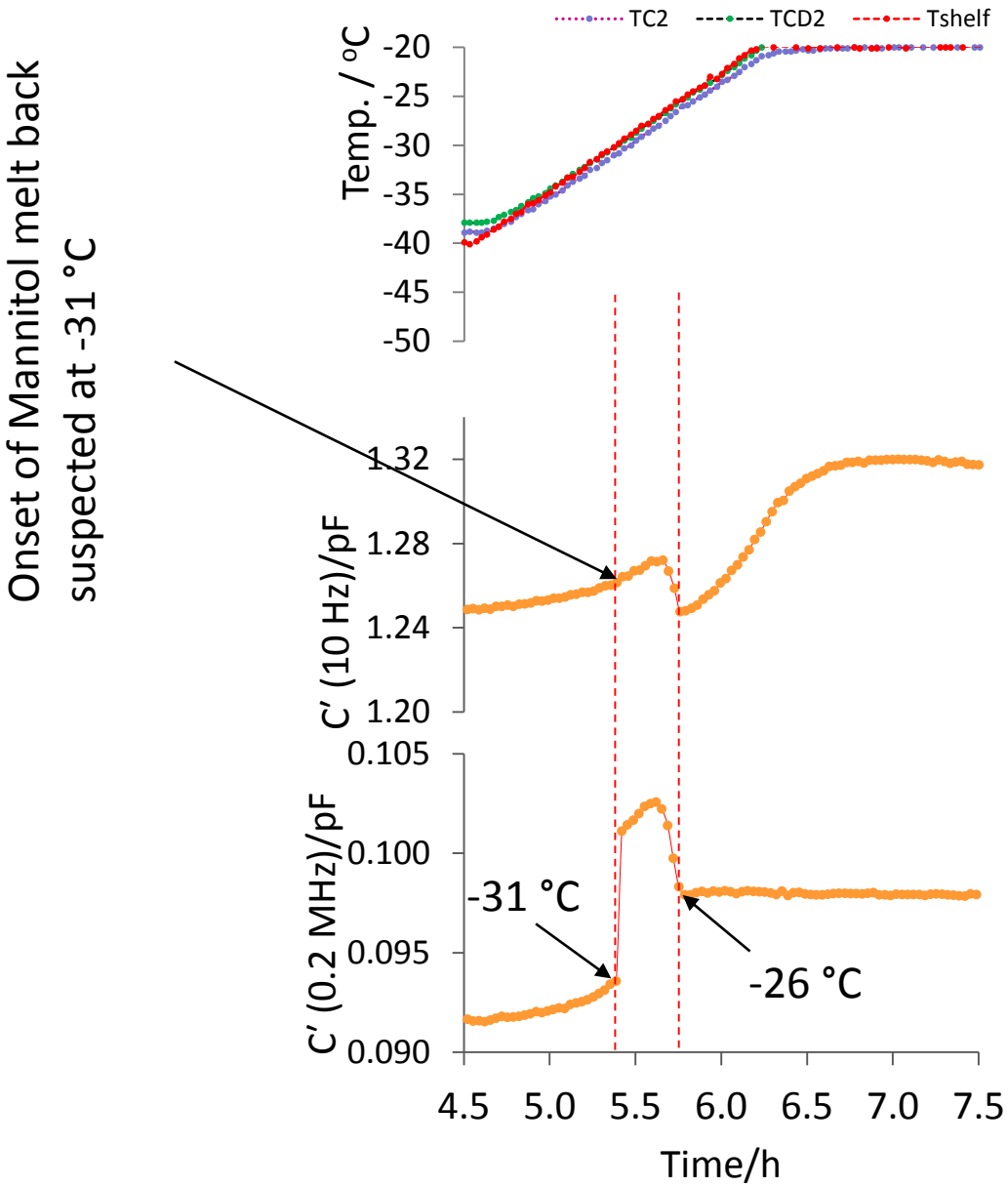
Time period around mannitol crystallization (3 min before and after)

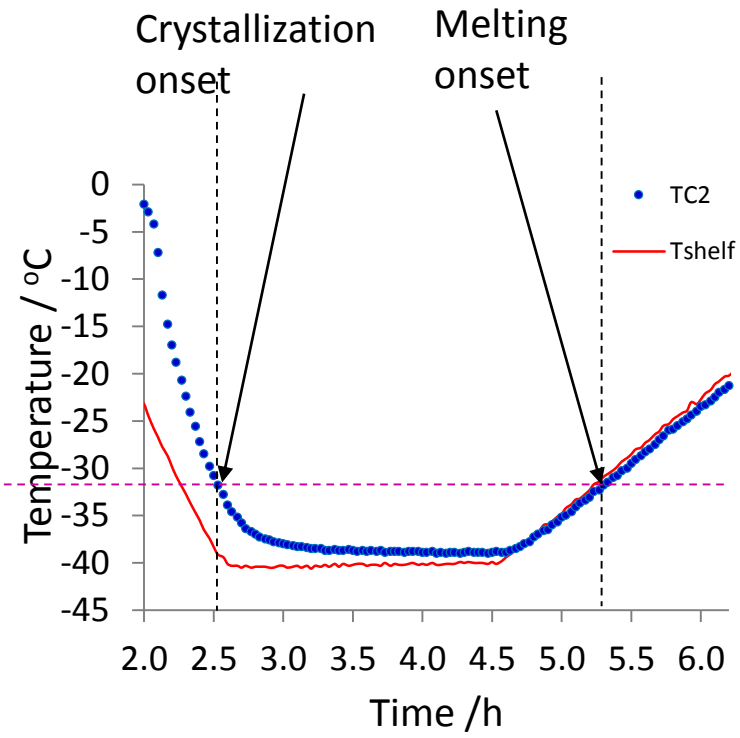


Re-heating period: melting of mannitol crystals



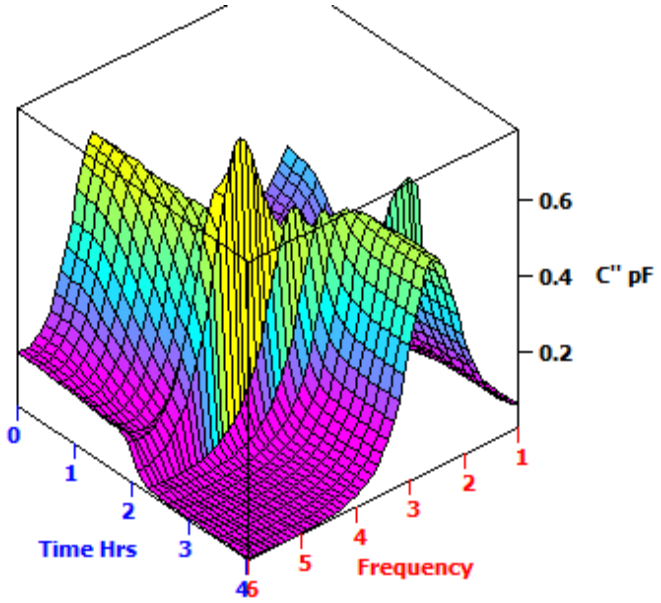
Re-heating period: melting of mannitol crystals

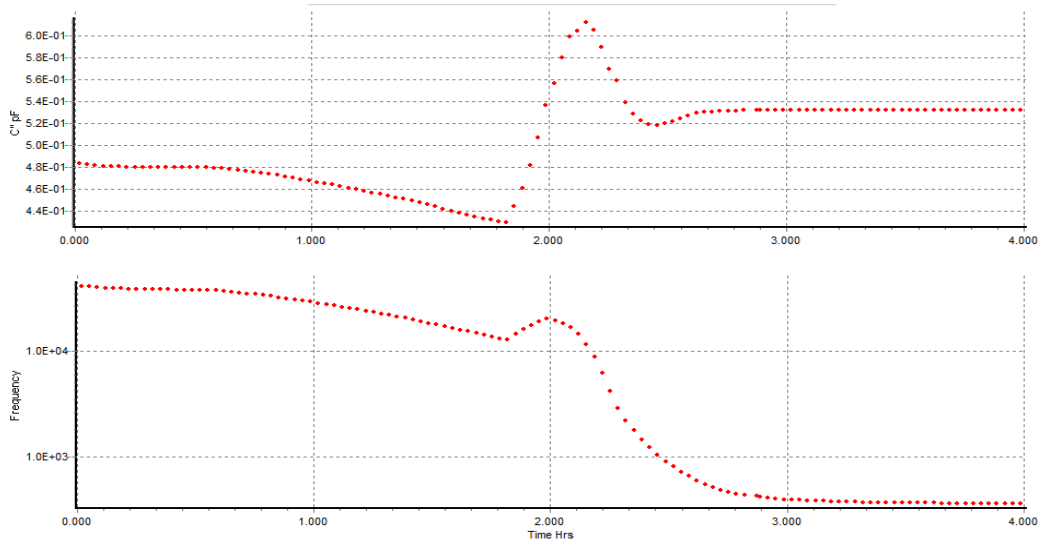




LyoView™ Data Presentation

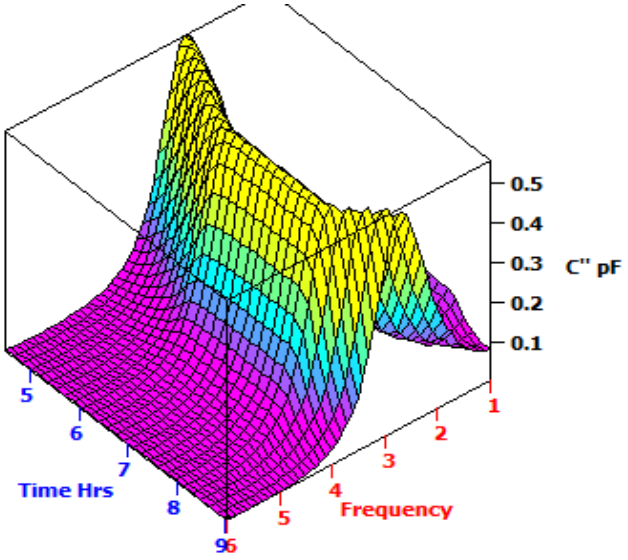
Freezing step

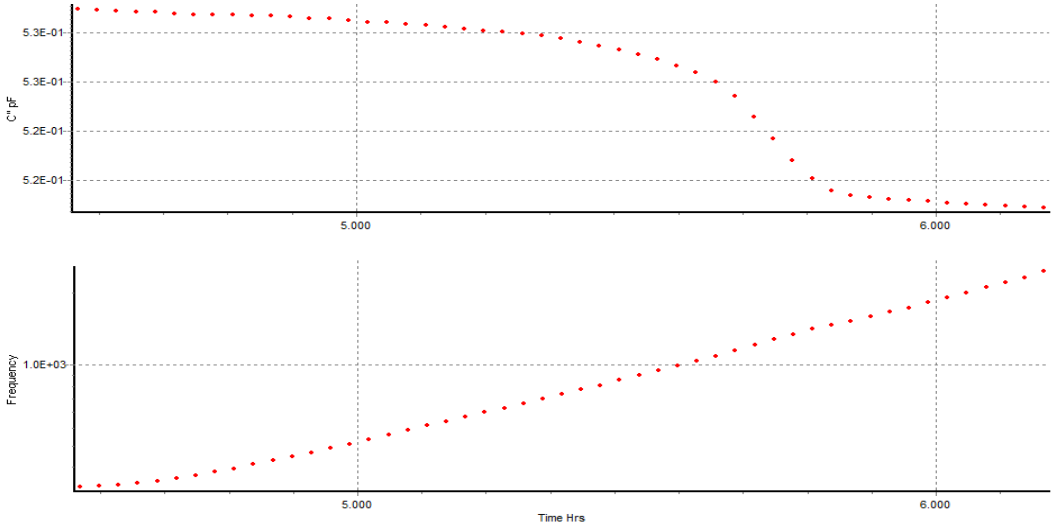




Freezing step

Annealing step





Re-heating period