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Proposal

Yageo-NCKU Technology Collaboration on Green Heat Processing for MLCC Production

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Basically, MLCC is a sintered ceramic devise; the layered structure was formed by sintering of Ni internal electrodes and ceramic dielectrics – high-temperature heat process is indispensable

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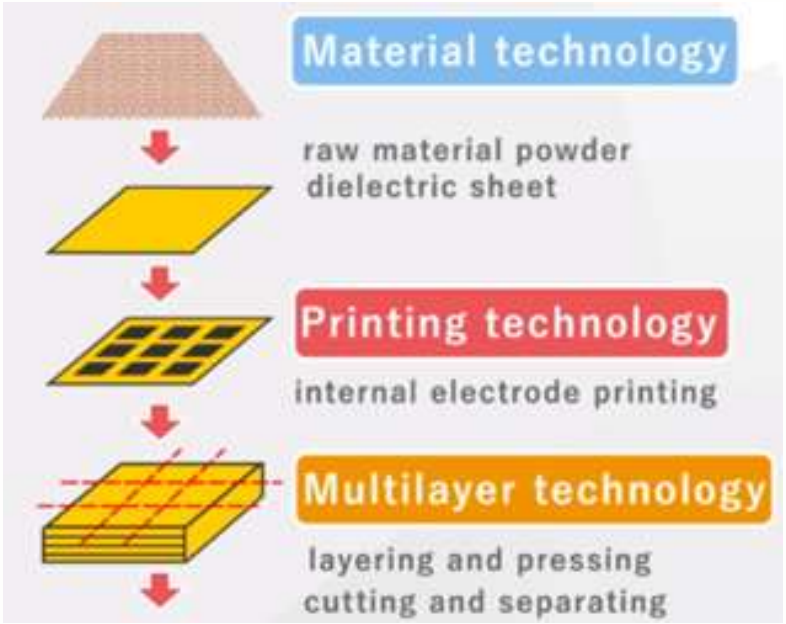
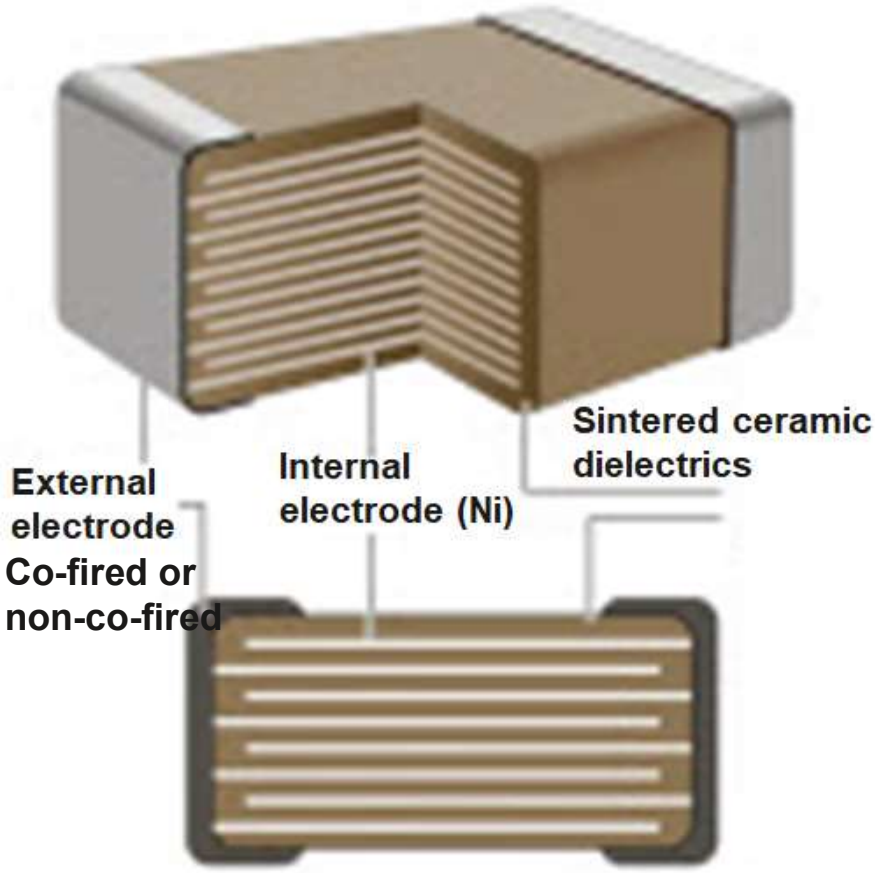
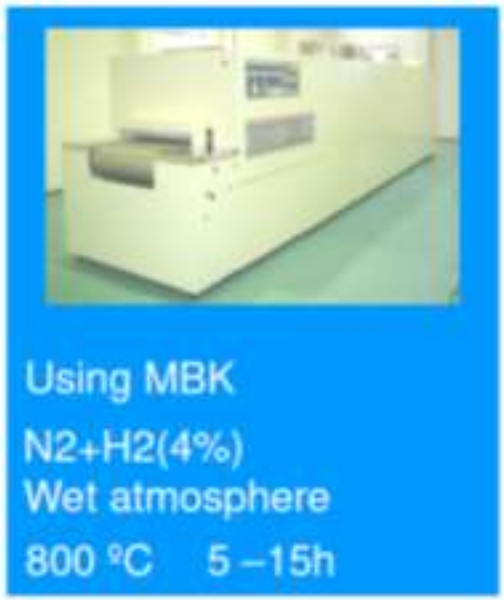


After binder burn out the chips are sintered at ~ 1300℃ in reducing atmosphere



Typical heat process flow of modern base metal electrode MLCC

Primary binder burn-out
by Batch Kiln



Secondary binder burn-out
by Mesh Belt Kiln

Sintering
by Roller hearth Kiln

Re-oxidation
by Mesh Belt Kiln

Each heat process is independent; MLCC chips are heated up then cooling down, and load and unload by operators, repeatedly – a lot of waste of energy and labor force! Also, quite long process time is required for binder burn out; it is critical for larger case size MLCC

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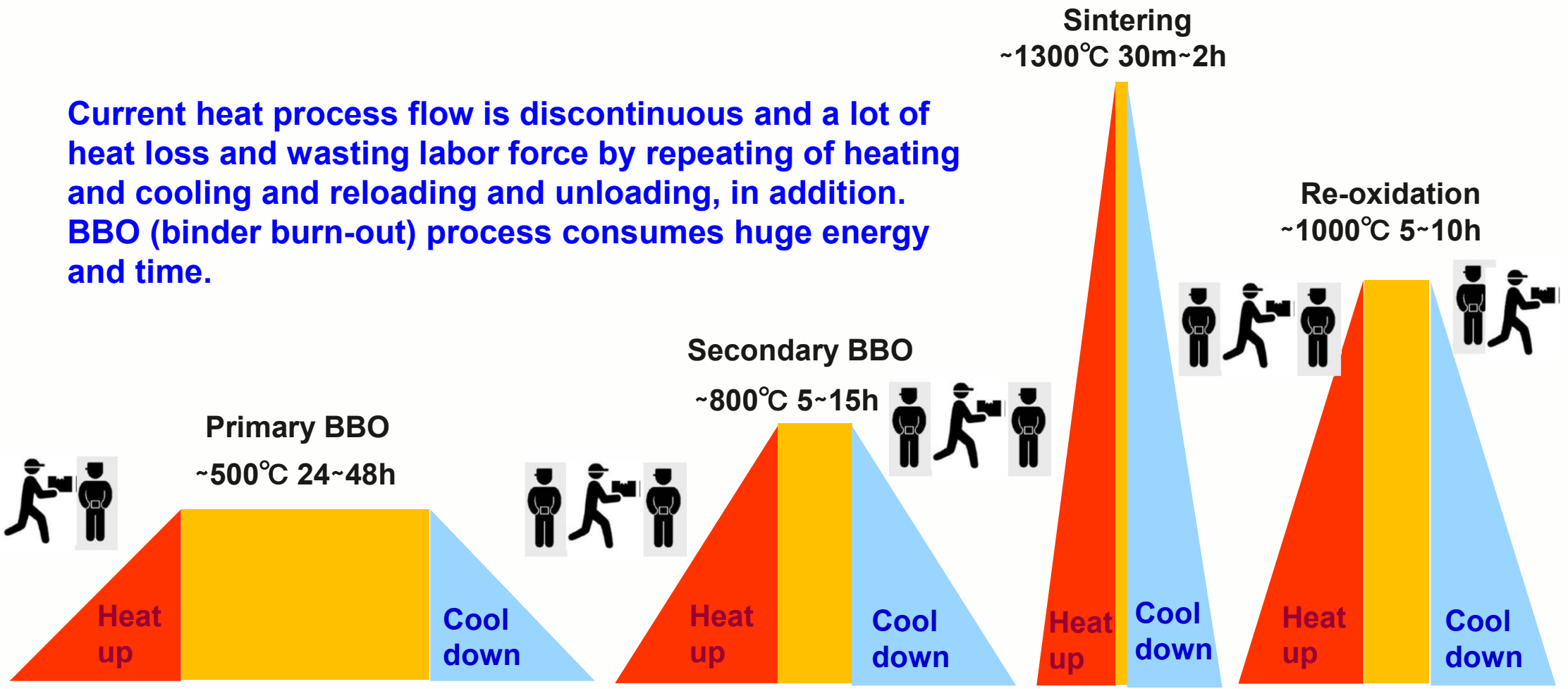
Heat process flow of time and temperature of MLCC production

Current heat process flow is discontinuous and a lot of heat loss and wasting labor force by repeating of heating and cooling and reloading and unloading, in addition. BBO (binder burn-out) process consumes huge energy and time.

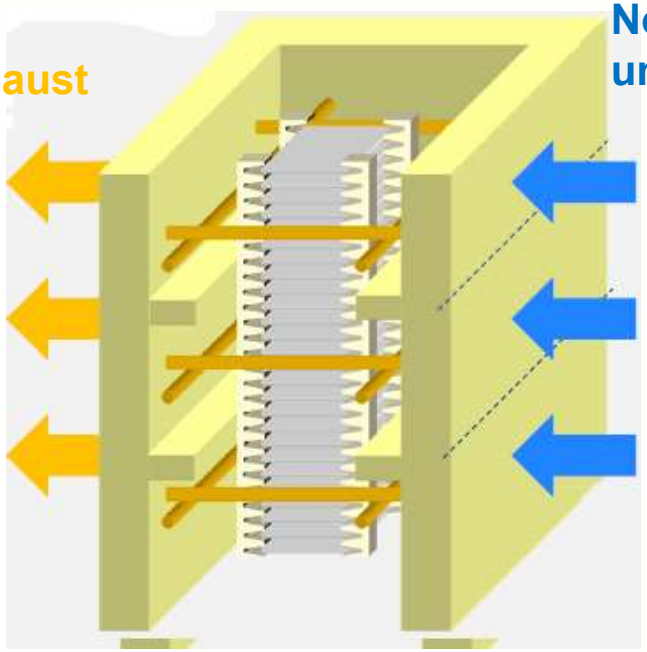


How to connect independent heat process!

Loading/unloading combination worked with cylinders

Displacing chamber

Displacing chamber



Note: quite unique gas flow !

Atmospheric gas supply

Recently NORITAKE filed their patents on “Stacker Kiln” which enable automatic load/unload of setters and vertical kiln structure with space saving; it has a potential to combine independent heat process of MLCC

How to shorten the binder burn-out process!

Recently superheated steam binder burn-out receives attention from MLCC manufactures for effective rapid binder burn-out method of MLCC

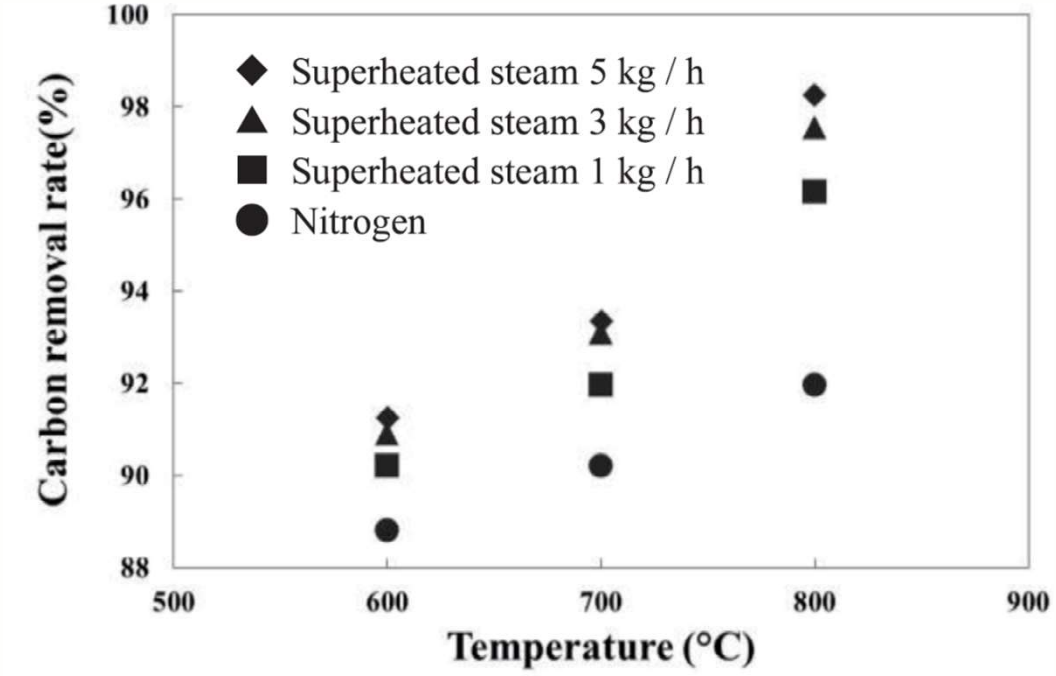
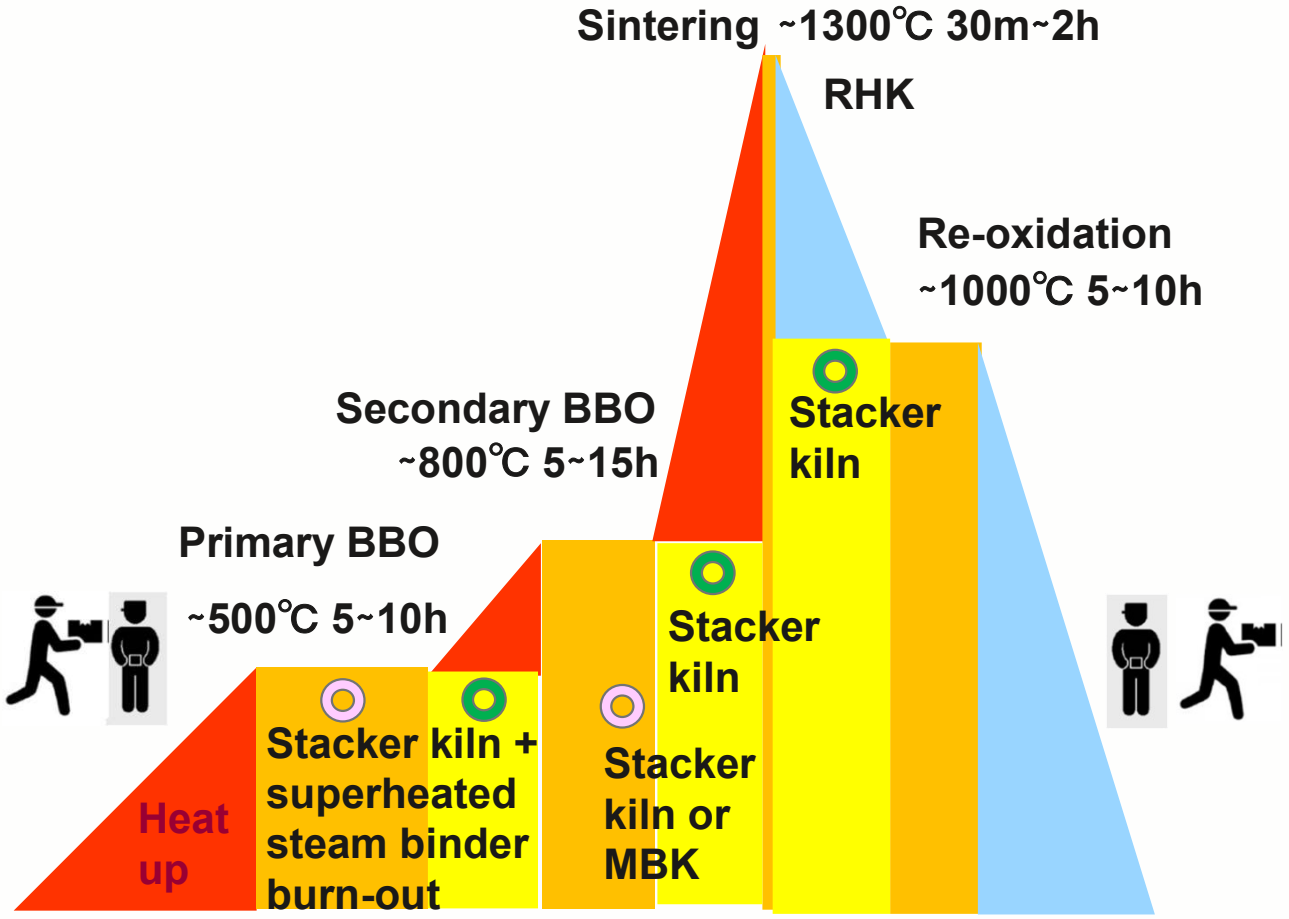


Fig.3 Carbon removal rate in the central portion of the alumina molded body with organic binder after debinding treatment.

Nakamura et al., J. Soc. Mater. Sci. Jpn., 69 [8] 612-617 (2020)

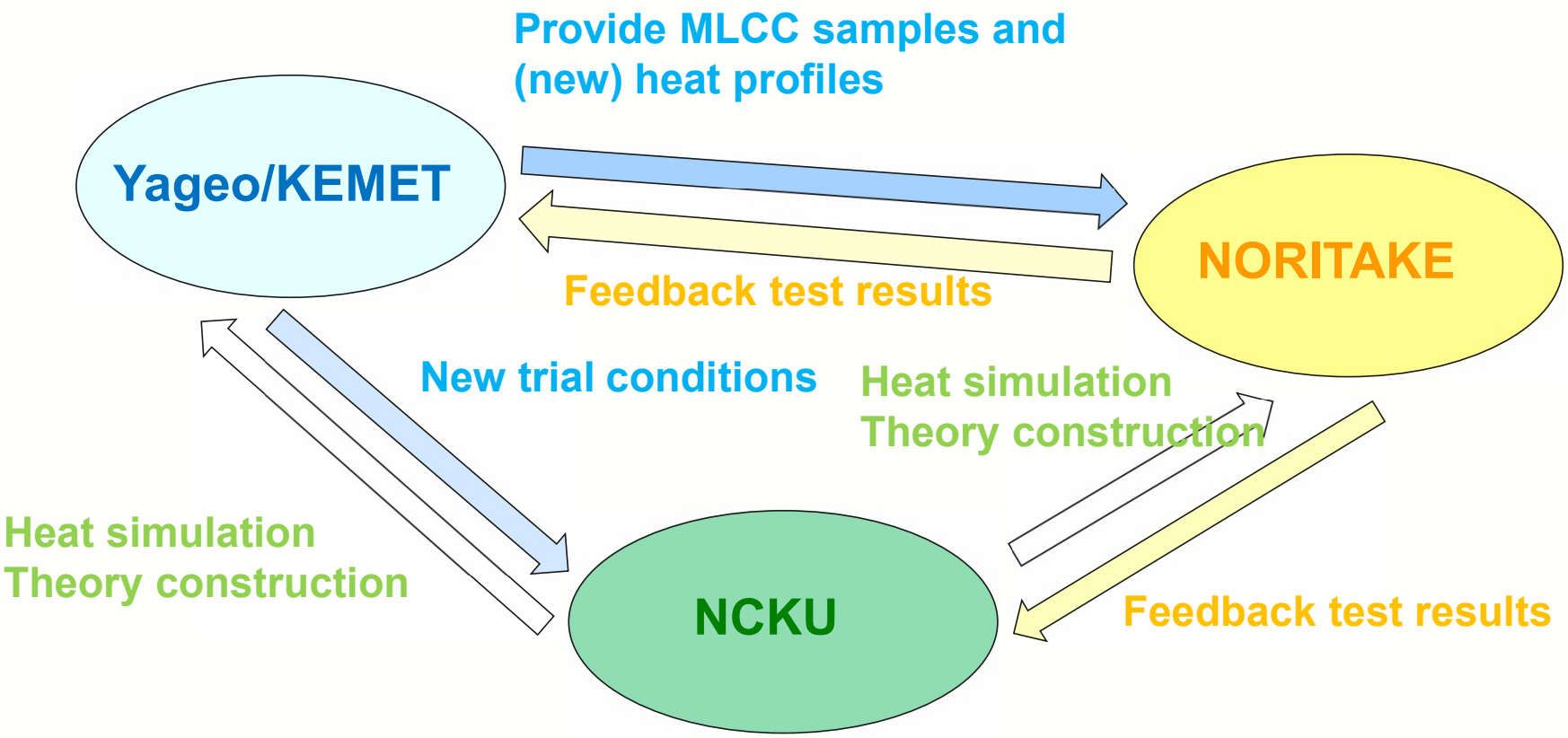
Yageo requested design and test of superheated steam binder burn-out of MLCC using their stacker kiln (the binder burn-out test is on going between Yageo and NORITAKE), however how work their unique gas flow system and superheated steam binder burn-out mechanism are unknown. Simulation of gas (steam) flow and theory construction are required! Need NCKU support !!

If the heat process was continuous and short time BBO realized, it will be green and economical process



Schematic heat process flow using stacker kilns we can draw, but there is no precise energy saving calculation with how much reduction of carbon emission! Need NCKU support !!

Feedback Loop between Three Bodies for Green Heat Processing for MLCC Production



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Thank you