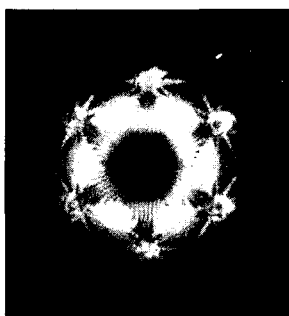


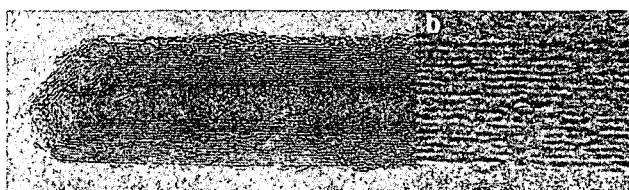
High temperature electron microscopy using conventional TEM and dedicated STEM

T. Kamino

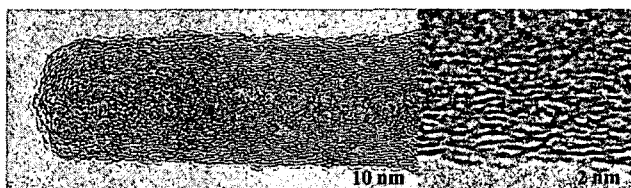
Hitachi Science Systems, Ltd.



HREM images of MWCNT at room temperature

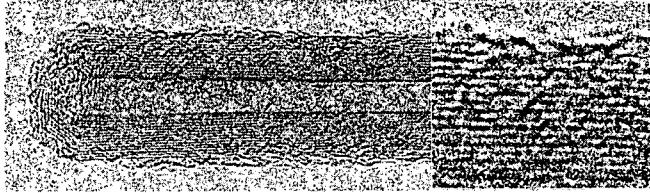


9.5×10^5 e/nm², 300kx, 2s

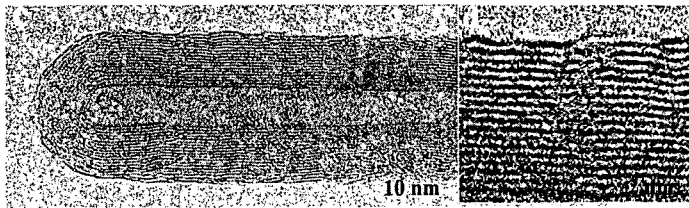


6.6×10^8 e/nm², 300kx, 20min.

HREM images of MWCNT at 500°C.

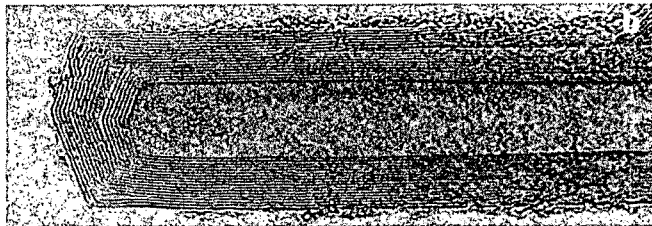


9.5x10⁵ e/nm², 300kx, 2s

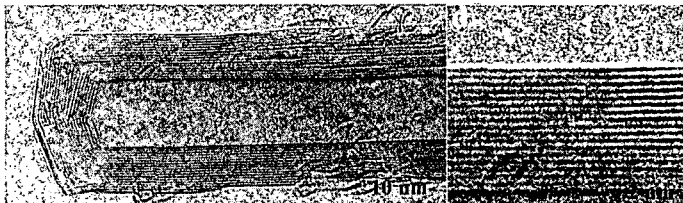


6.6x10⁸ e/nm², 300kx, 20min

HREM images of MWCNT at 600°C.

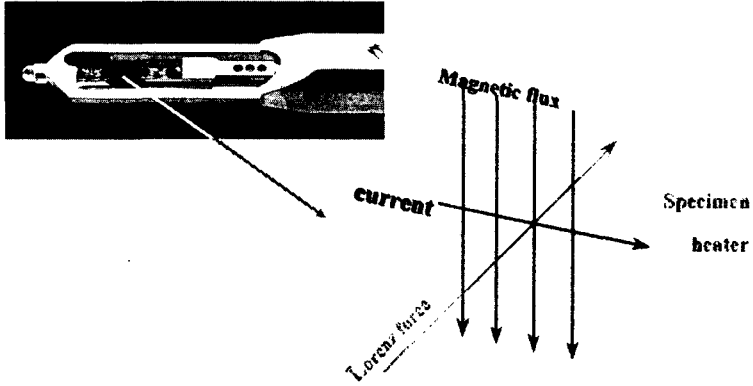


9.5x10⁵ e/nm², 300kx, 2s



6.6x10⁸ e/nm², 300kx, 20min

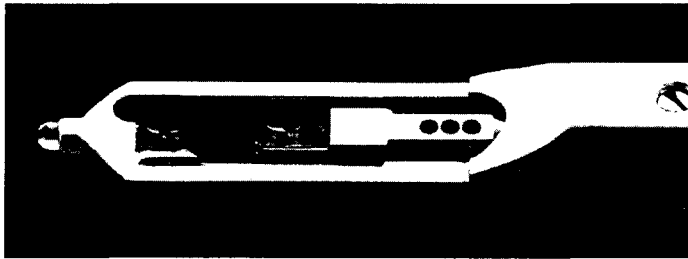
Spirally shaped heater employed in the high temperature specimen heating holder



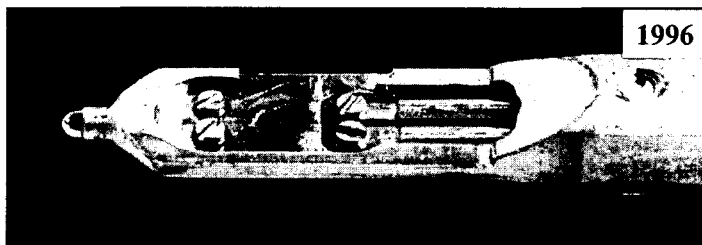
Advantage of the heater

Specimen drift due to expansion of the heated is driven by Lorenz force horizontally
⇒ little drift with no focus change even at very high temperatures

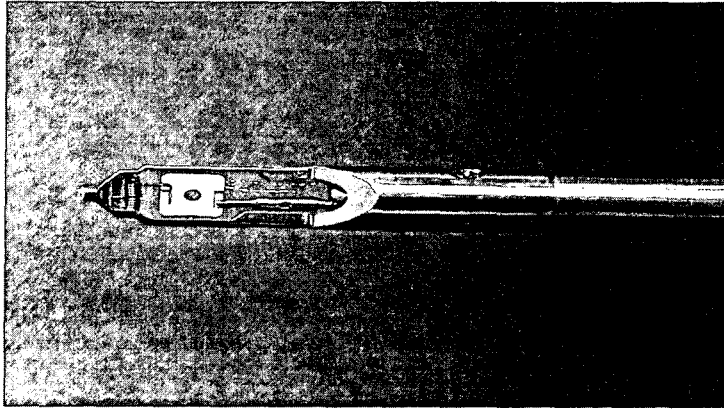
Specimen heating holders for high resolution TEM



Direct-heating type single-tilt specimen heating holder

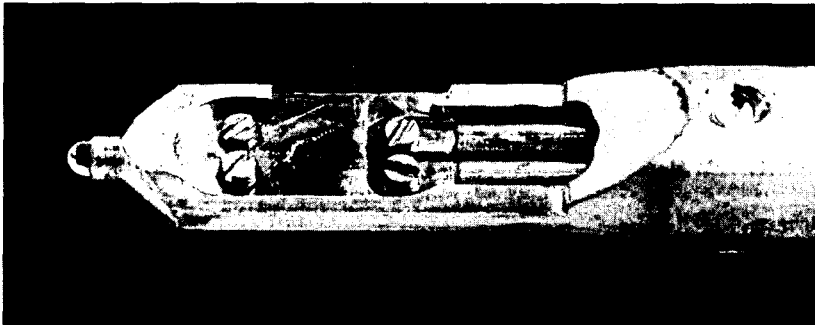


Direct-heating type double (and triple) heaters specimen heating holder



Double-tilt bulk specimen heating holder

Double-heater specimen heating holder



Conclusion

- A method for in-situ high temperature-high resolution electron microscopy at 1500°C or higher temperatures has been developed.
- High resolution TEM observation and EELS analysis of carbon nano tube at 200kV were successfully carried out at 600°C.
- The results of the experiment reveals that high temperature specimen heating holder can be effectively applied to nano-materials characterization.