

Red glasses

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Possible red glass pigments from literature

- Au
- Ag
- Cd/S/Se
- Cr/Pb
- Cu
- Mo/S
- Nd/Se
- Ni
- Sb/S
- U

Red glass pigments

- Au
- Ag

- Cu
- Mo/S
- Nd/Se
- Ni

Red glass pigments

Red glass pigments

- Au
- Cu
- Nd/Se \rightarrow Mo/Se?

Copper ruby

Cu_2O or Cu?

Role of SnO?



After 189 hours of heat treatment.

0.025 mol% Cu_2O

0.0625 mol% SnO



408°C



452°C



481°C



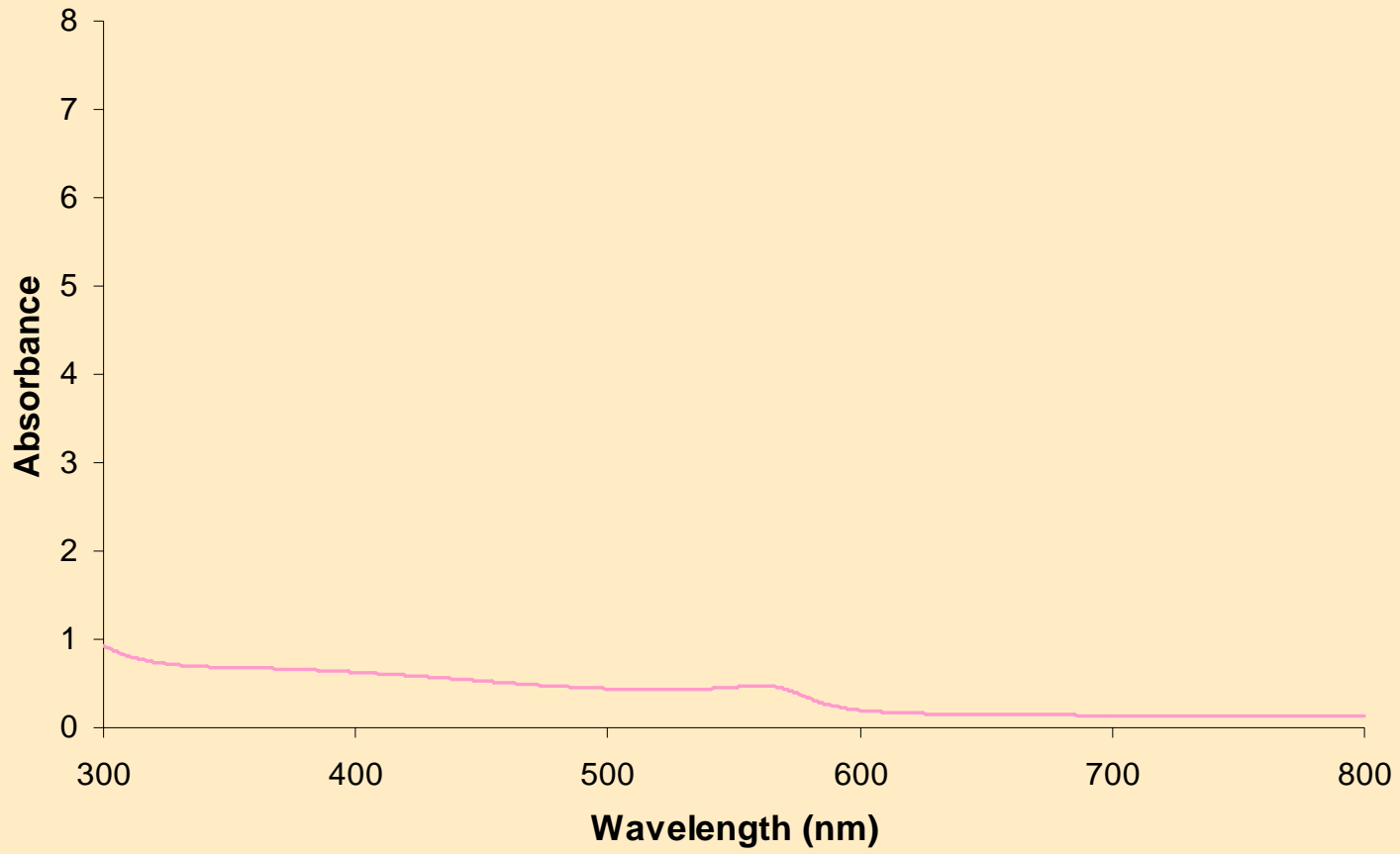
508 °C

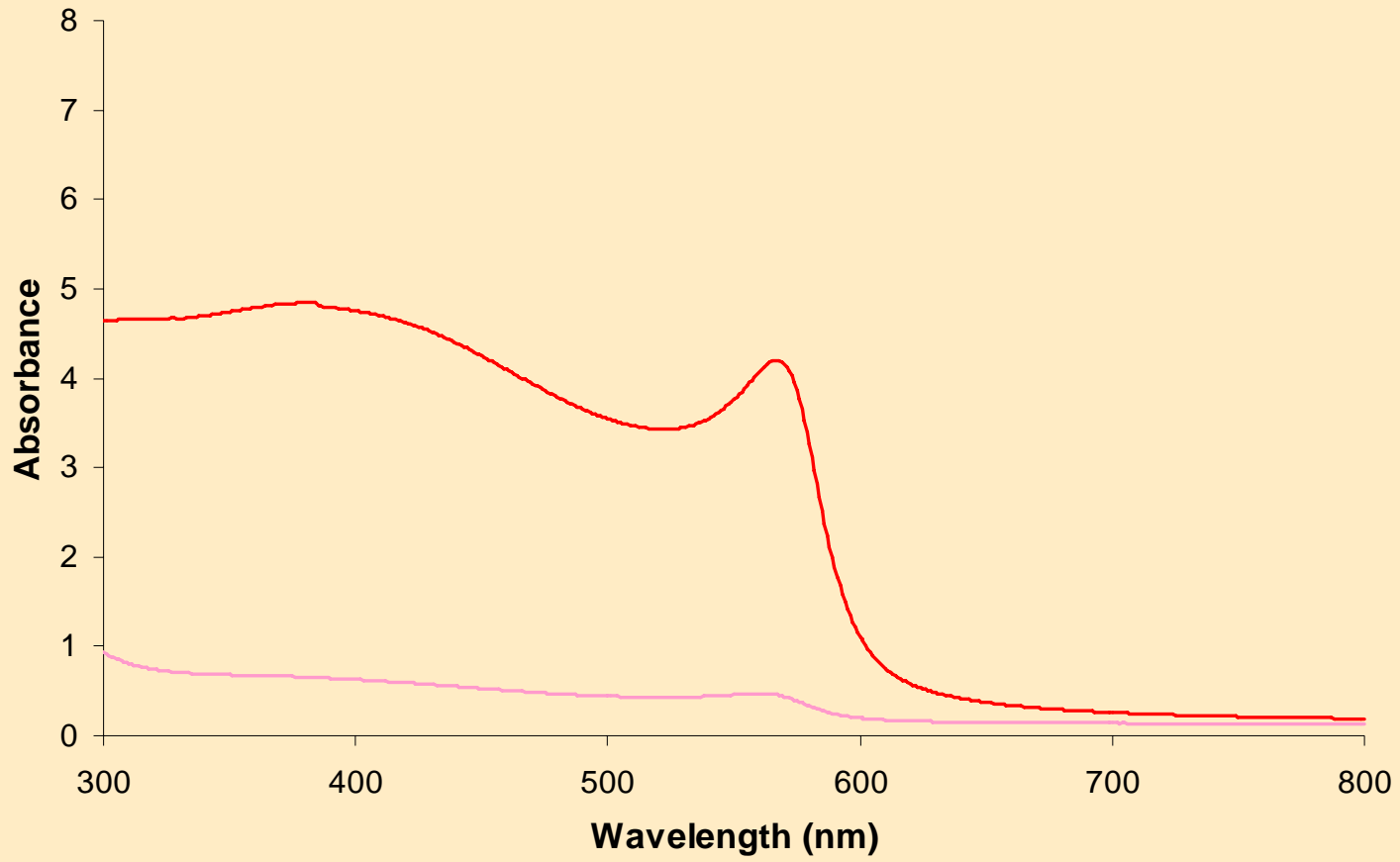


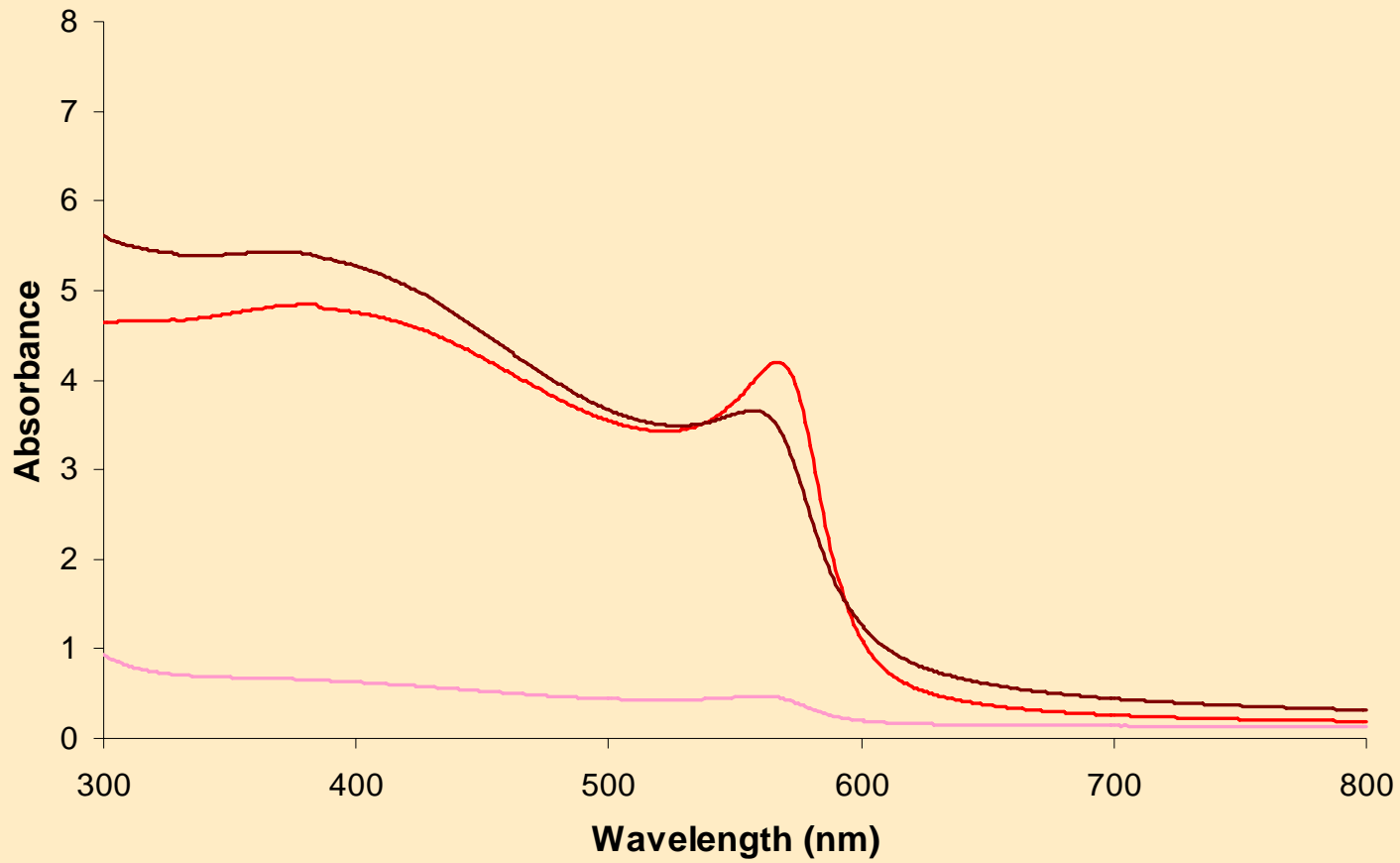
532°C

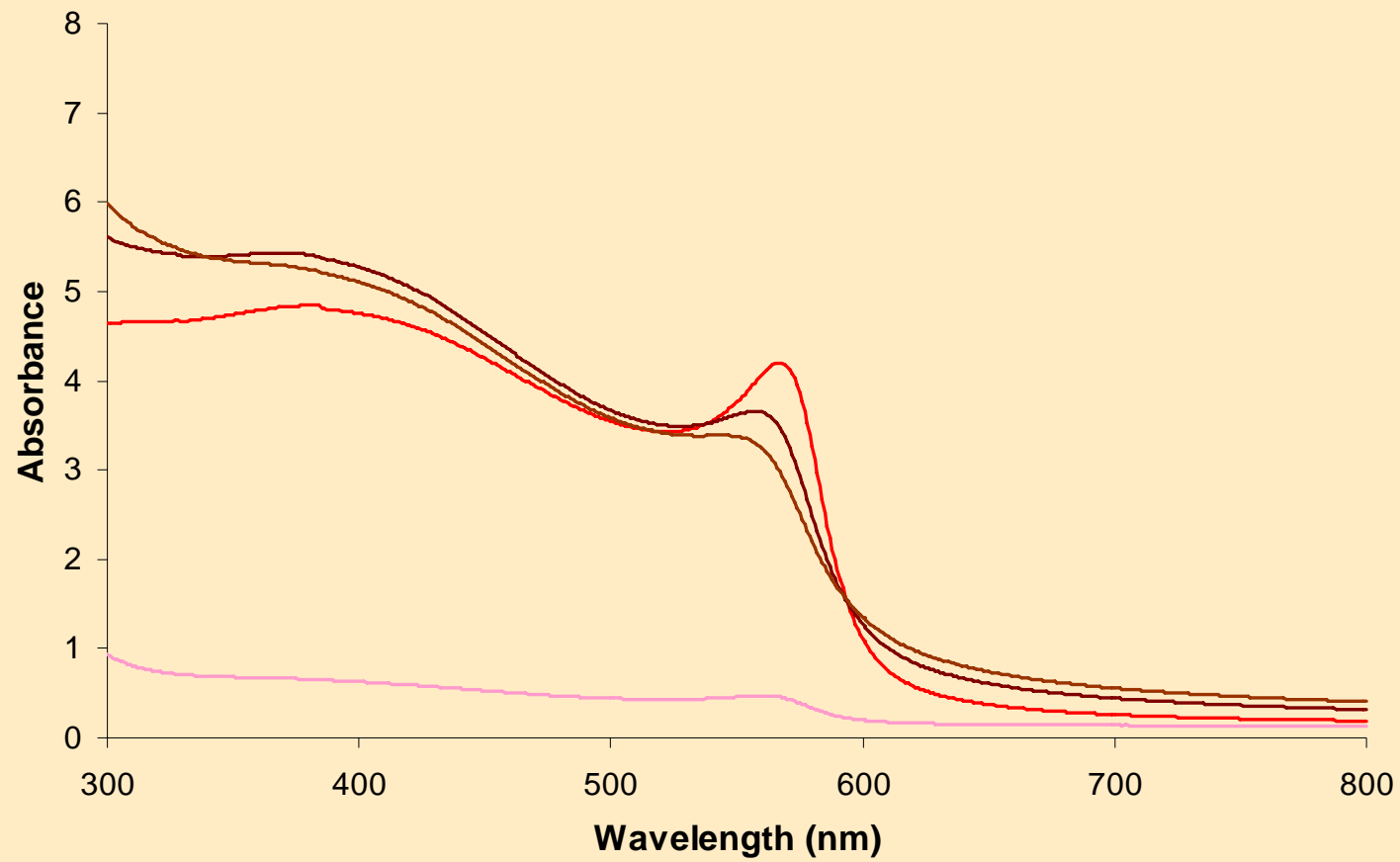


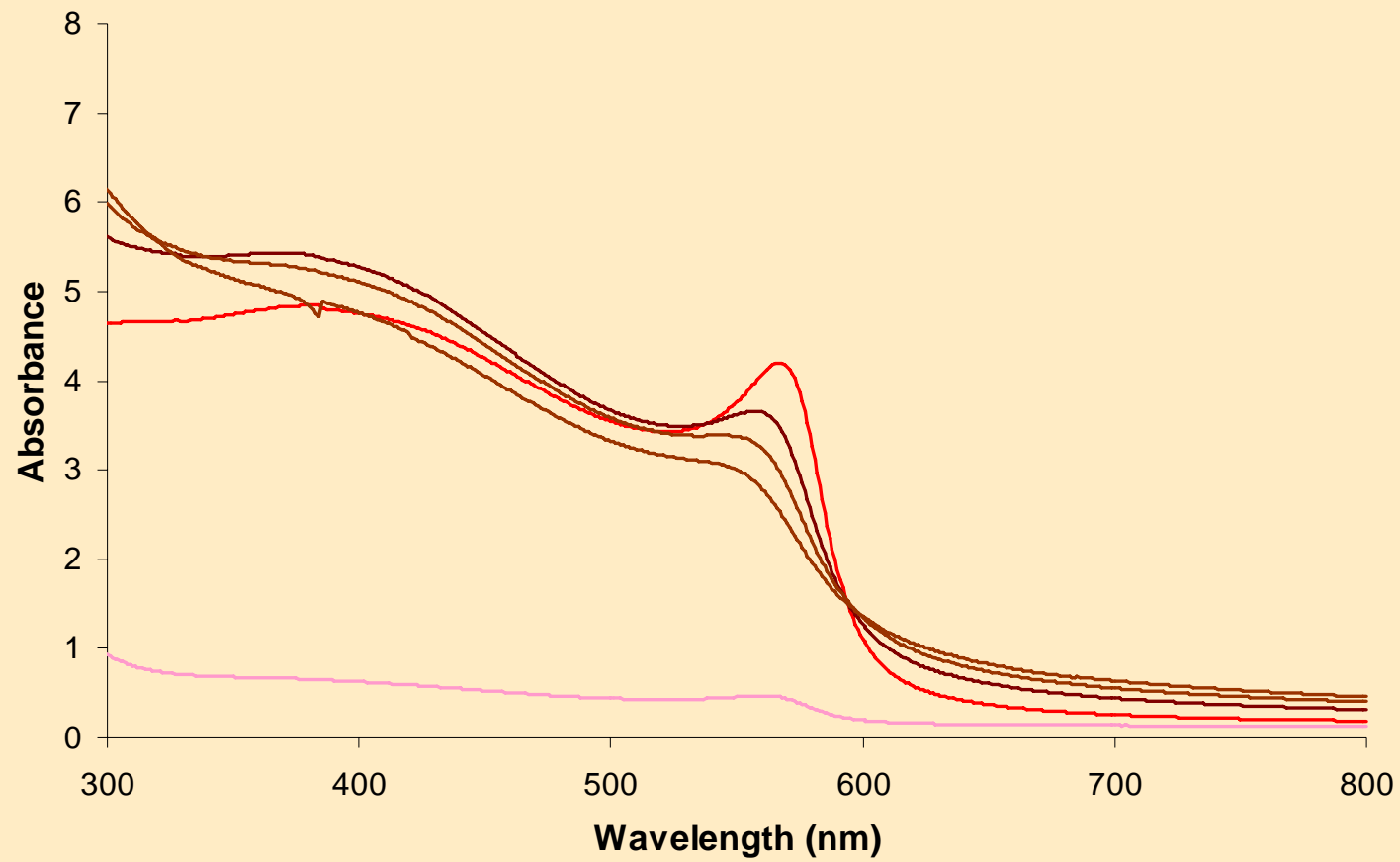
555°C

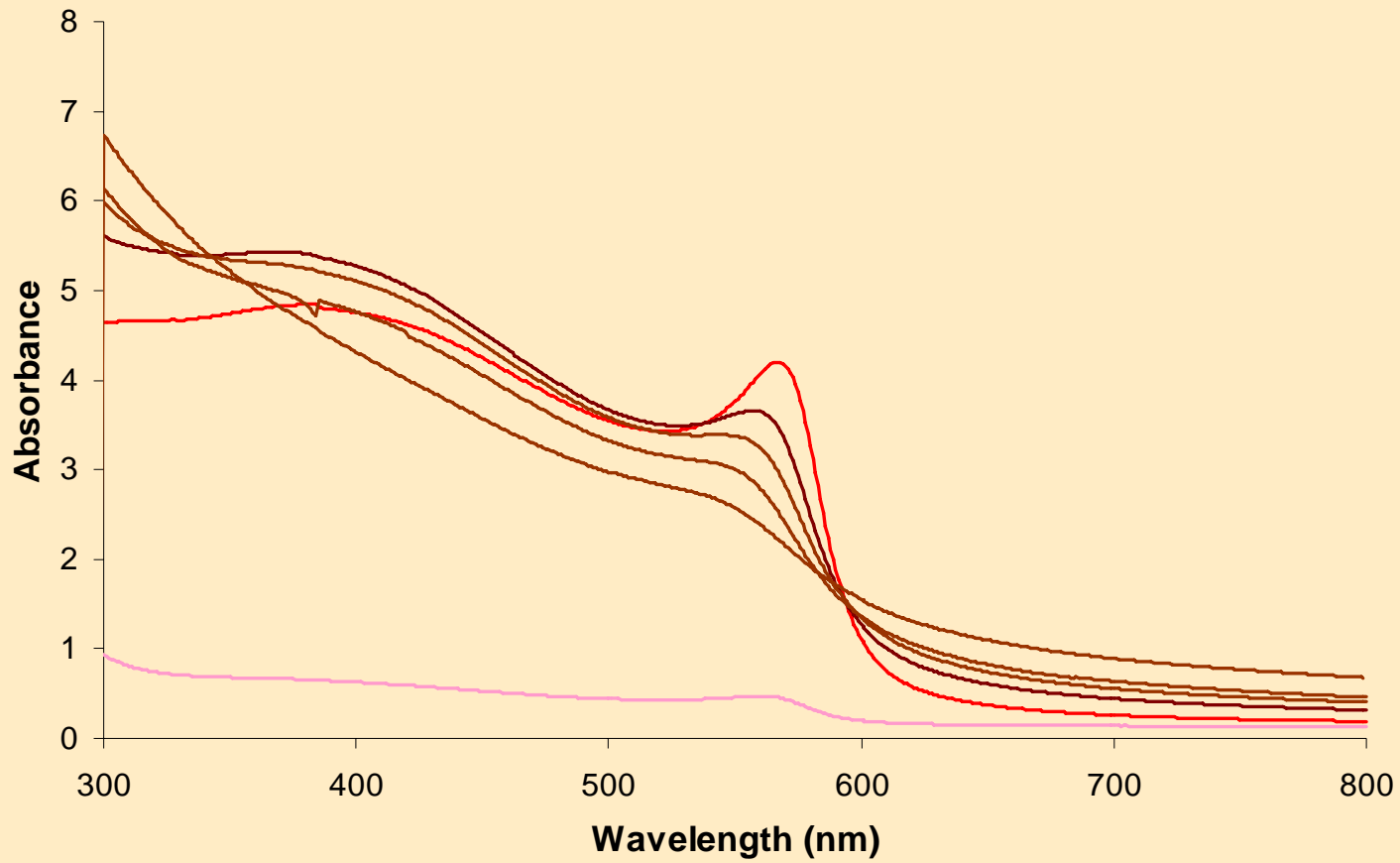


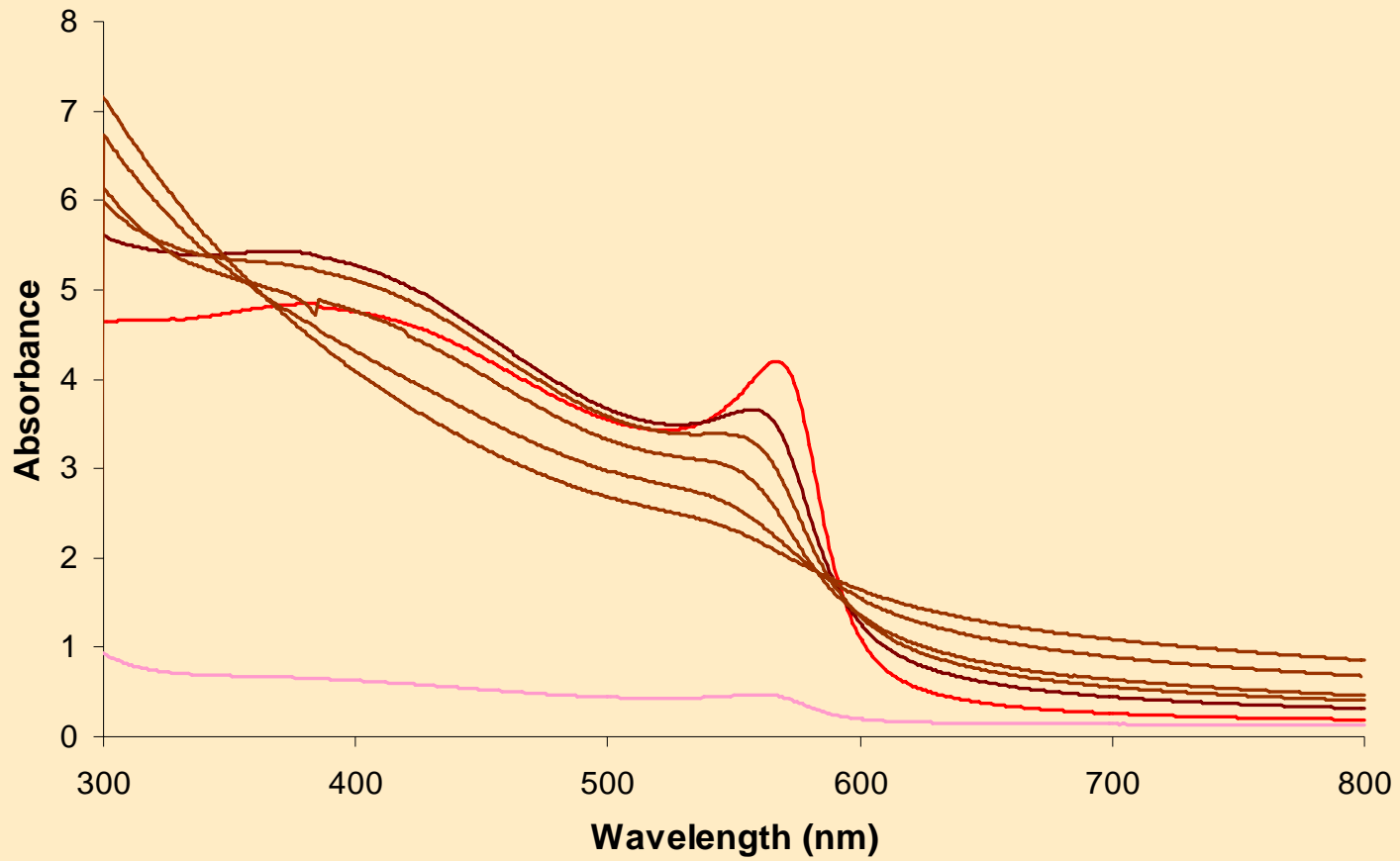


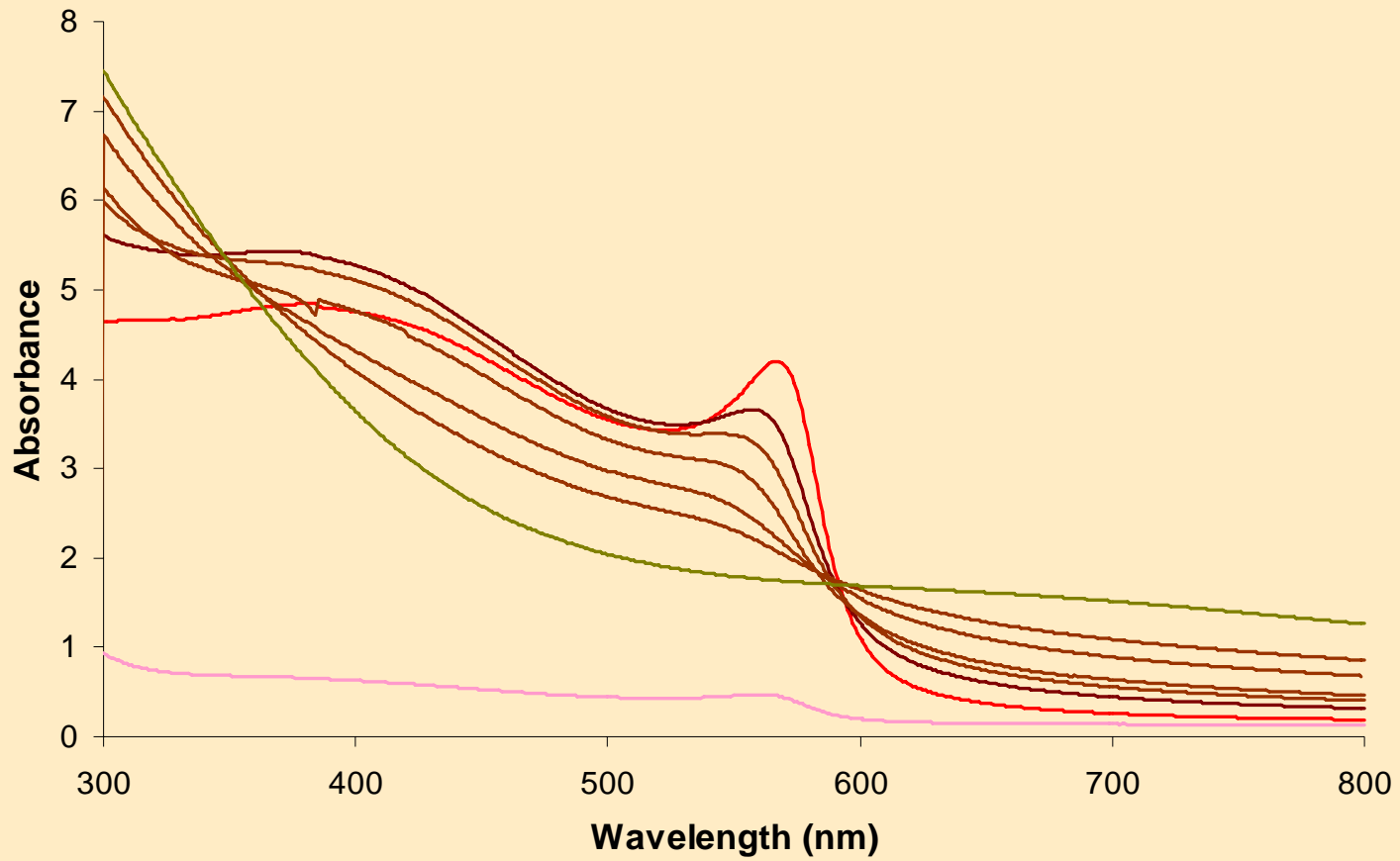


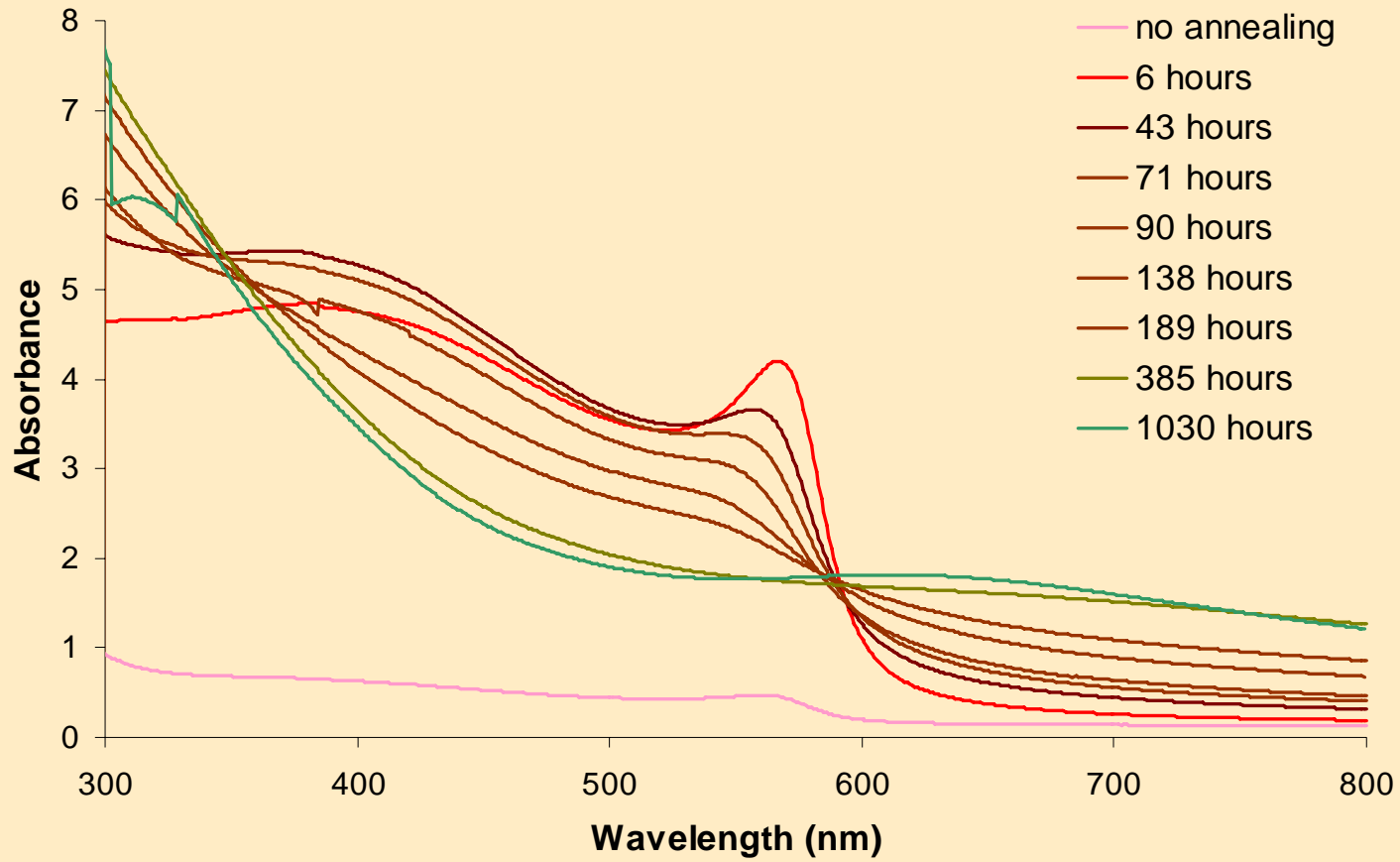




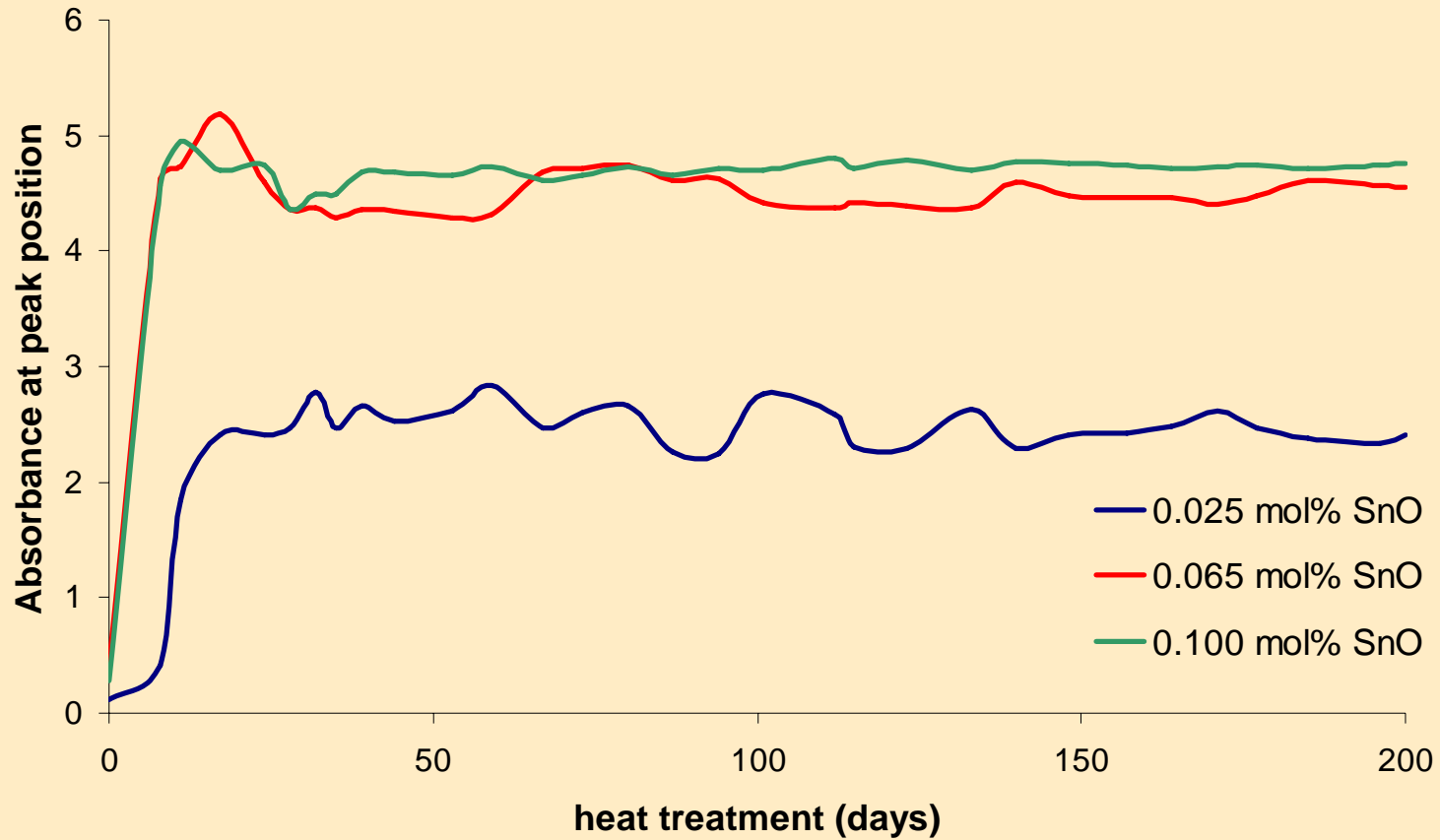




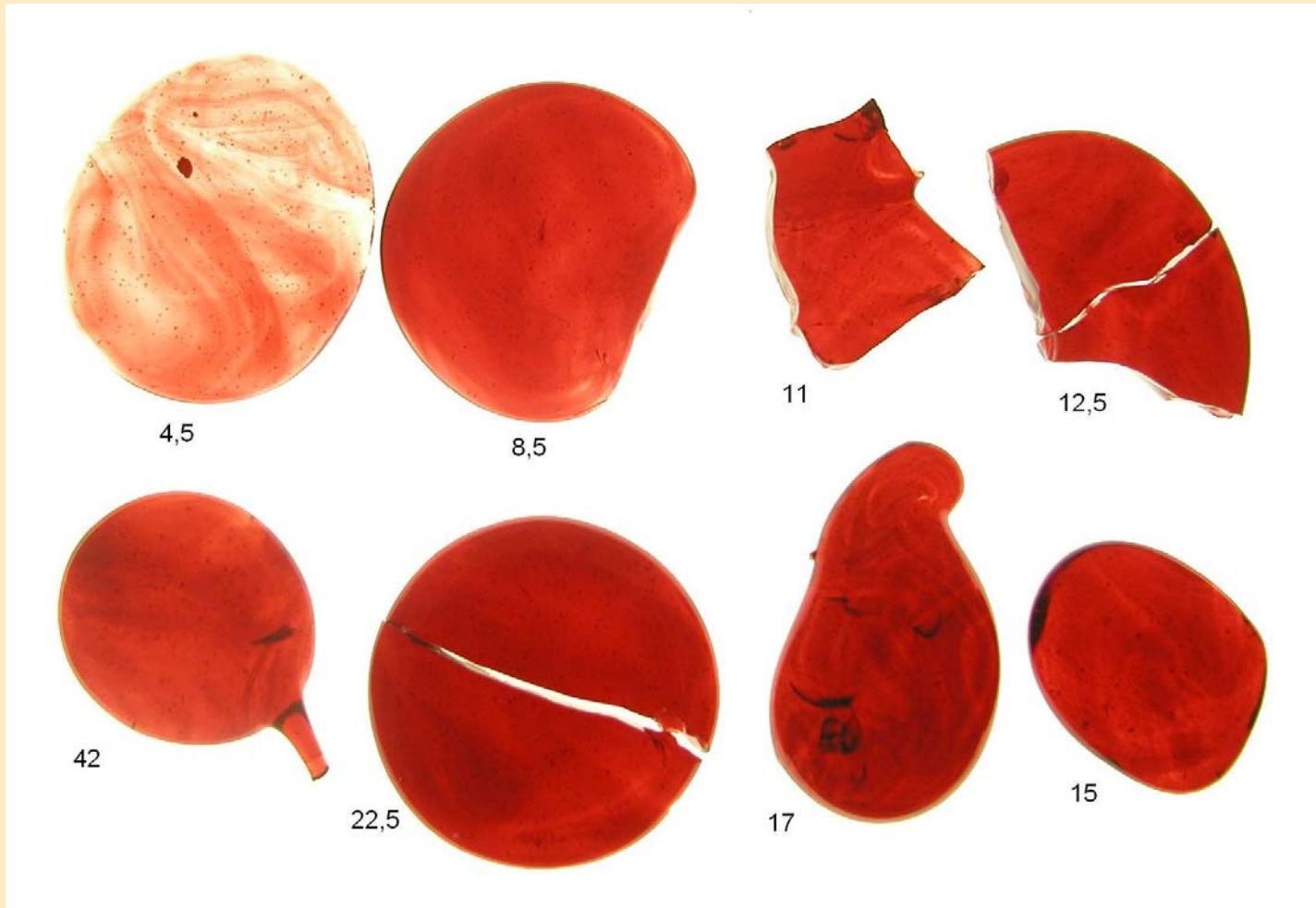




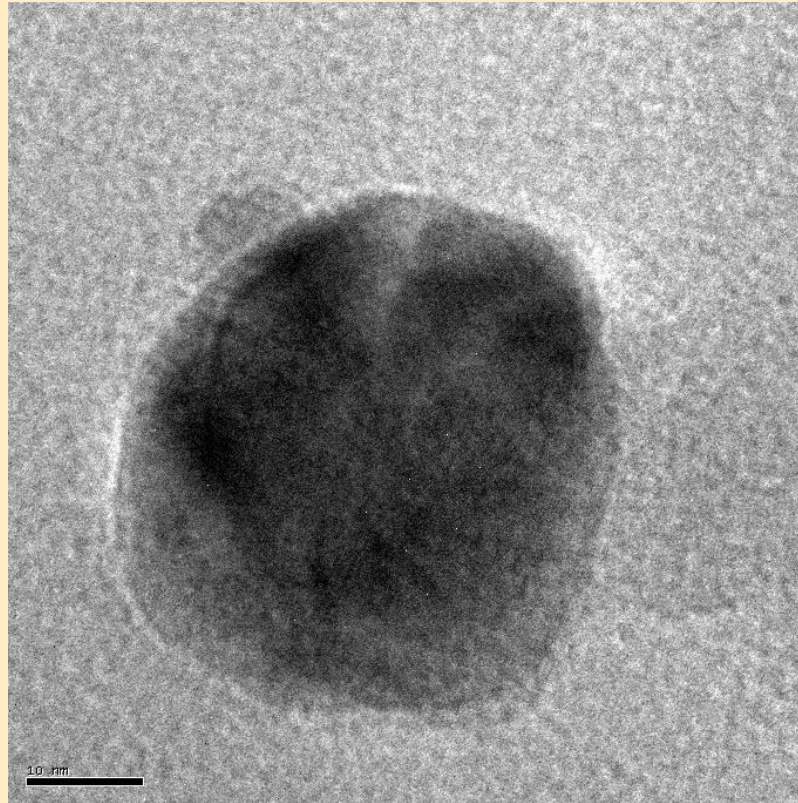
Shift in absorbance 480 °C



Heat treated at 535 °C. Thickness 3 mm

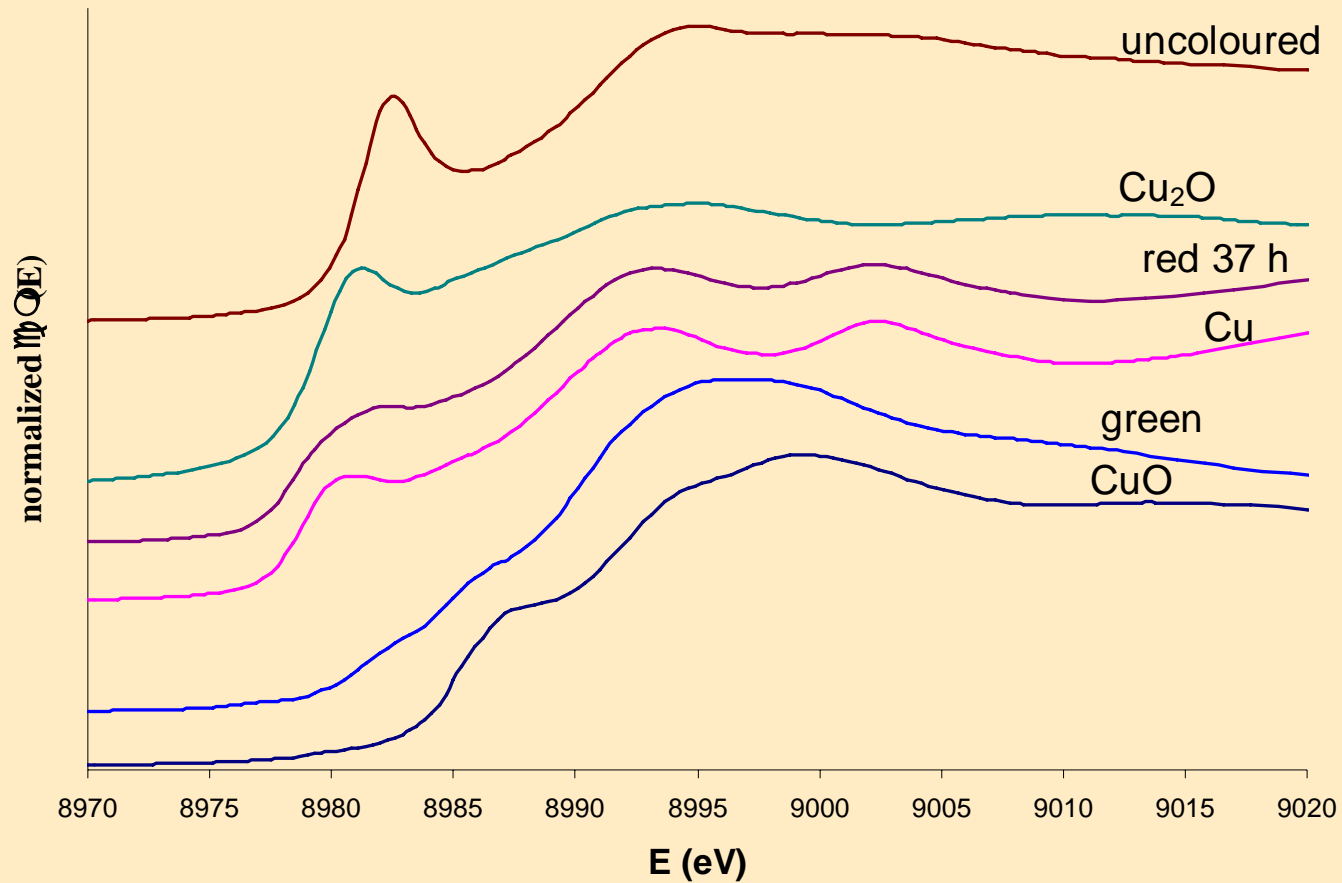


Transmission Electron Micrograph

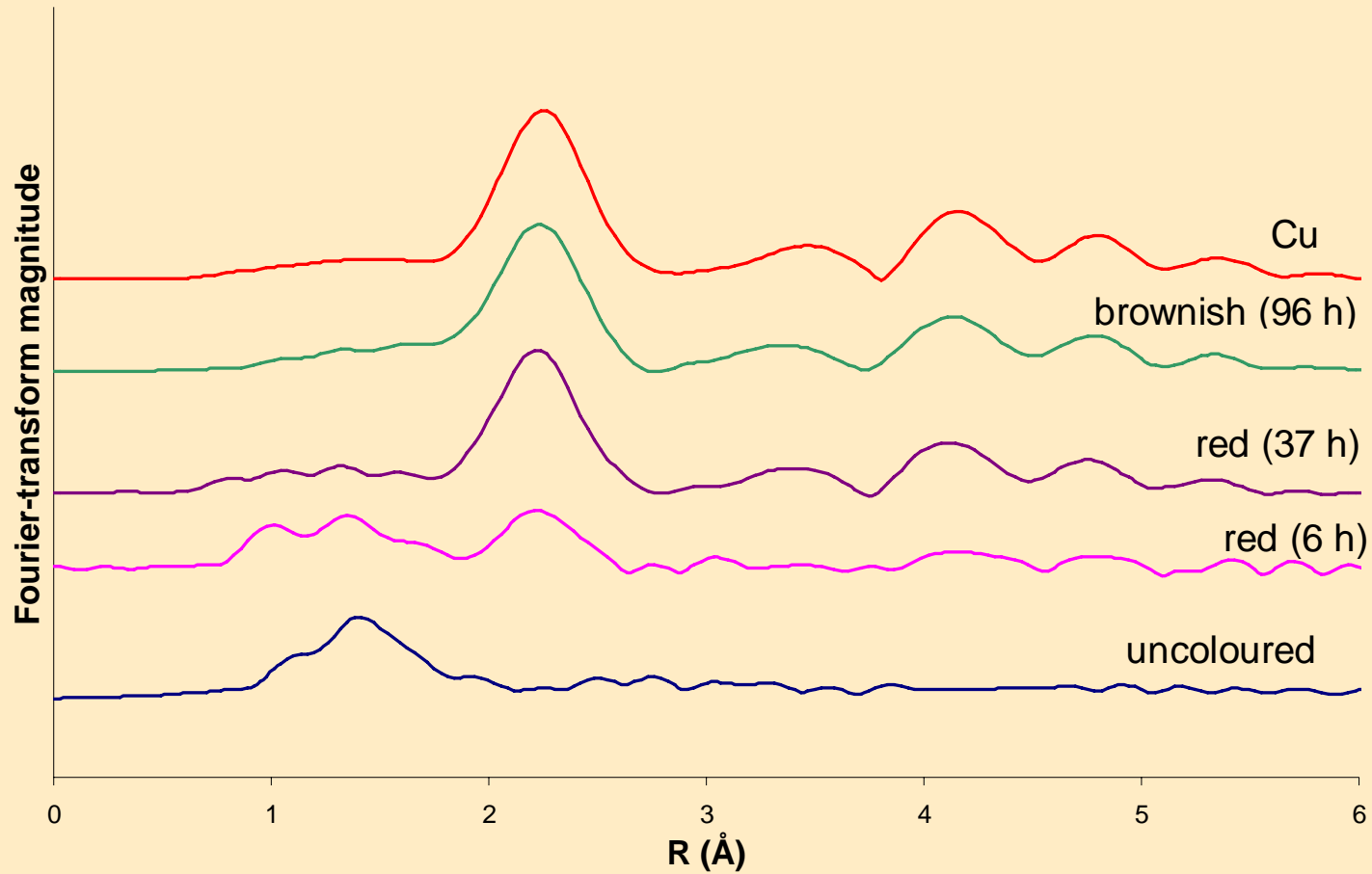


crystalline metallic Cu particle
 ≈ 40 nm

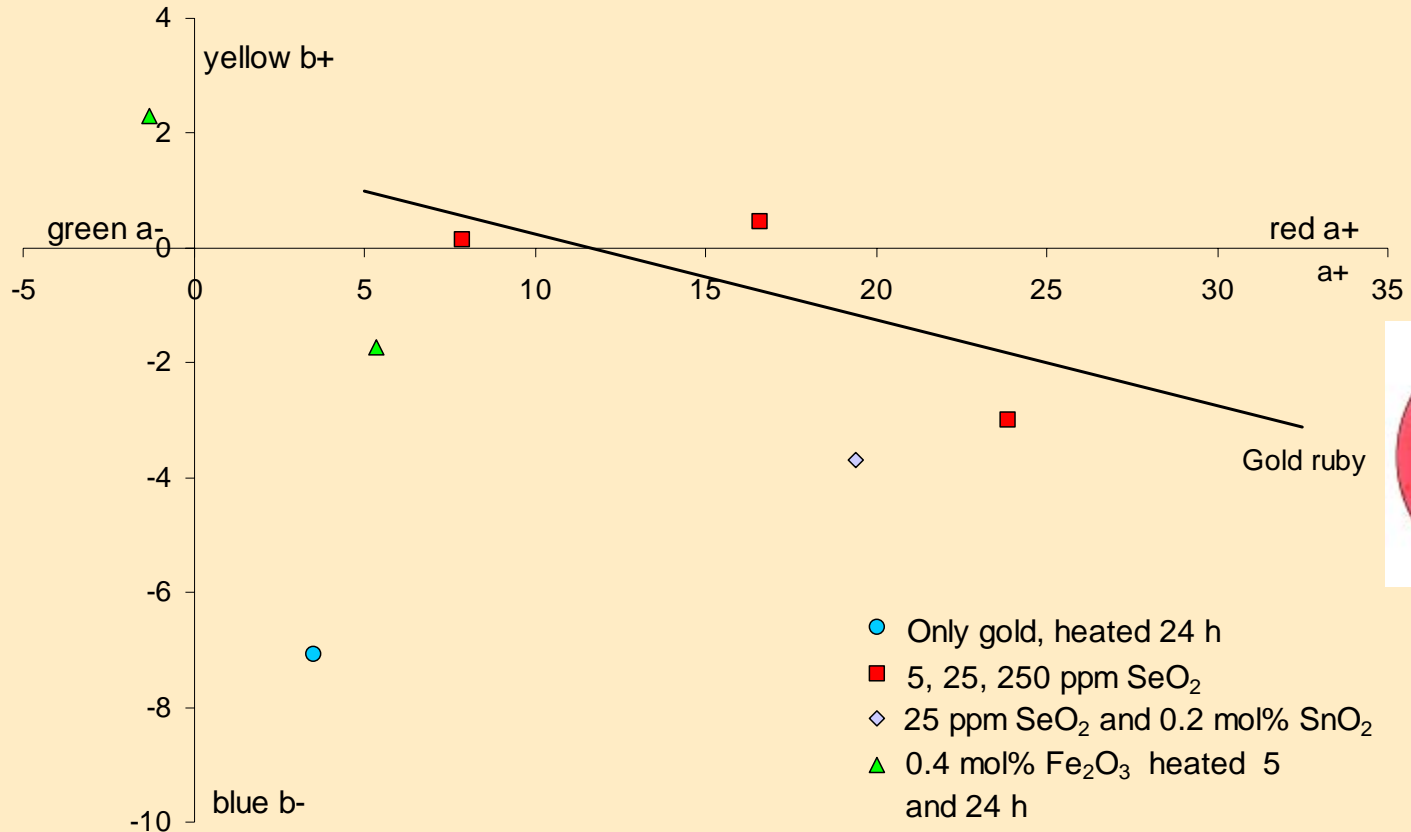
XANES - oxidation state



EXAFS – Cu reference



Gold ruby – impact of additives



molybdenum/selenium colour

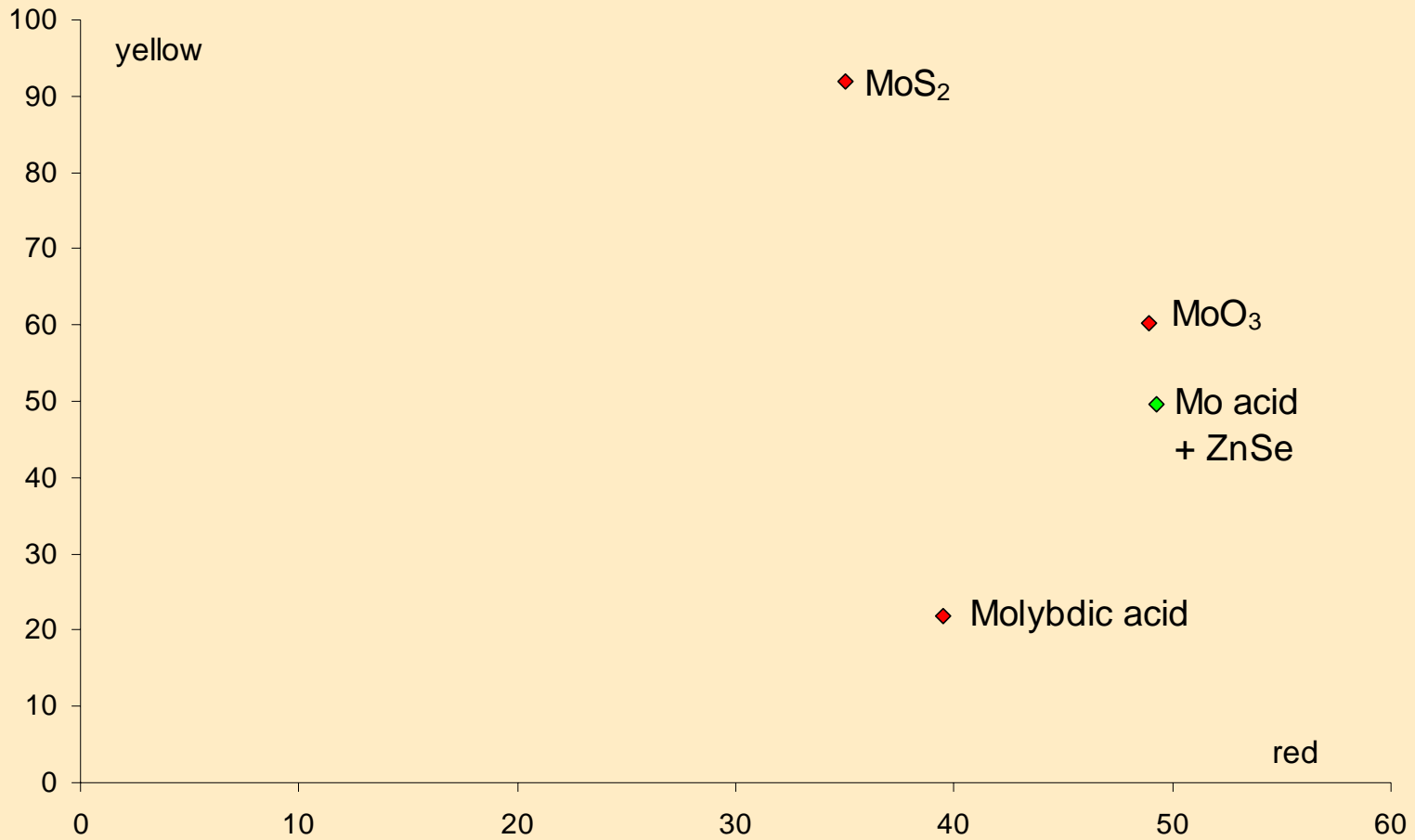
- MoS_2
- MoO_3
- Molybdic acid
- K_2MoO_4



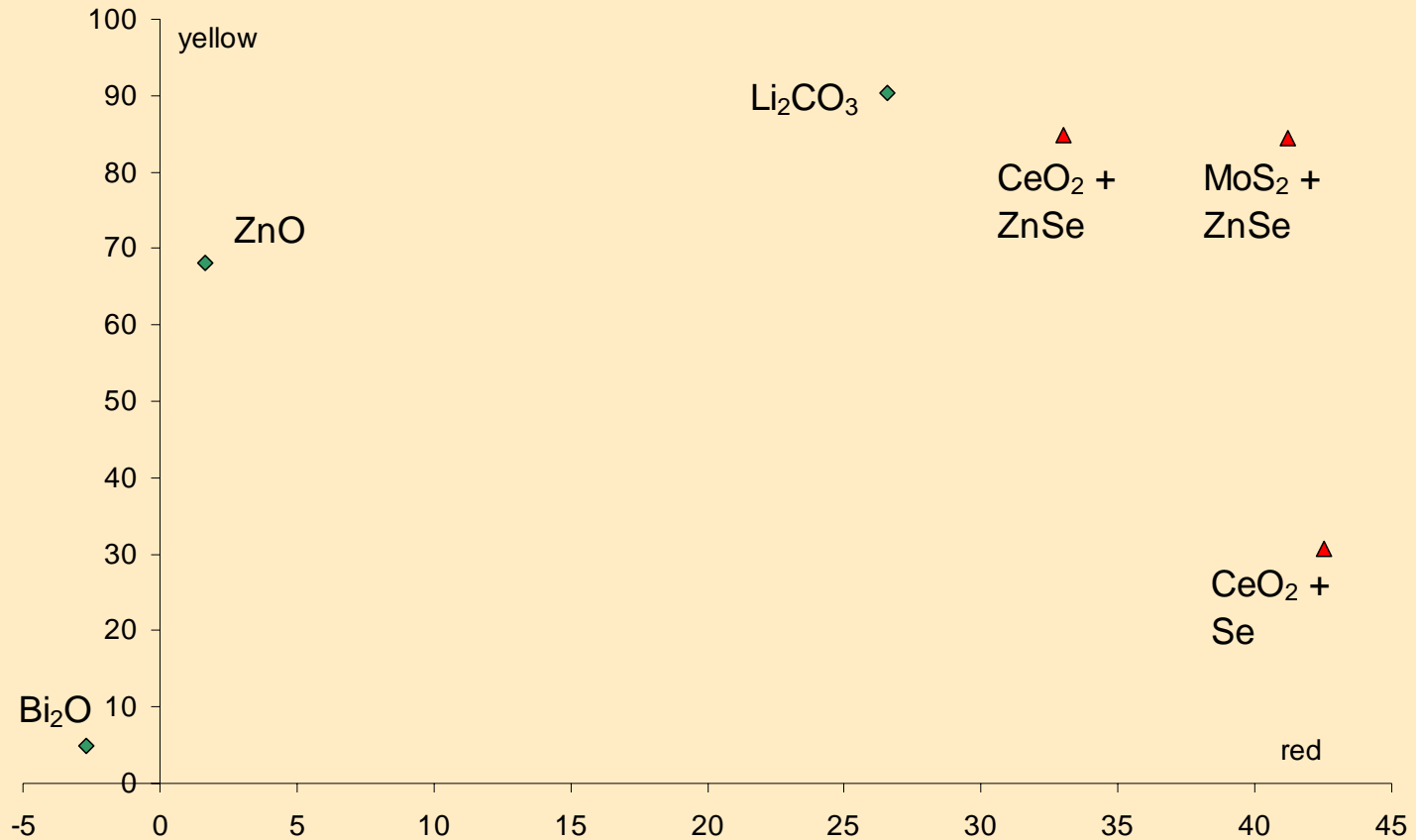
- Se
- ZnSe
- CaSe
- Na_2SeO_3

- Interaction between molybdenum and selenium?

molybdenum/selenium colour



molybdenum/selenium colour



Summary

- Copper ruby
 - Cu particles
 - SnO reducing agent
- Gold ruby
 - Se, Sn and Fe
 - higher melting temperatures
- Mo/Se
- ?



Thank you for your attention!

