

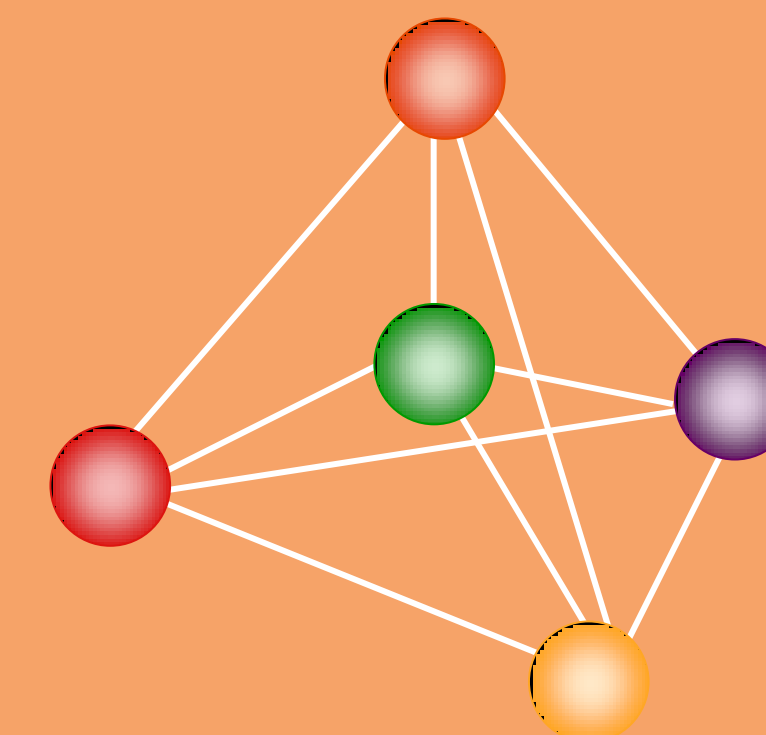


Crystal Growth of Co Film Fabricated by Electrodeposition with Supercritical Carbon Dioxide

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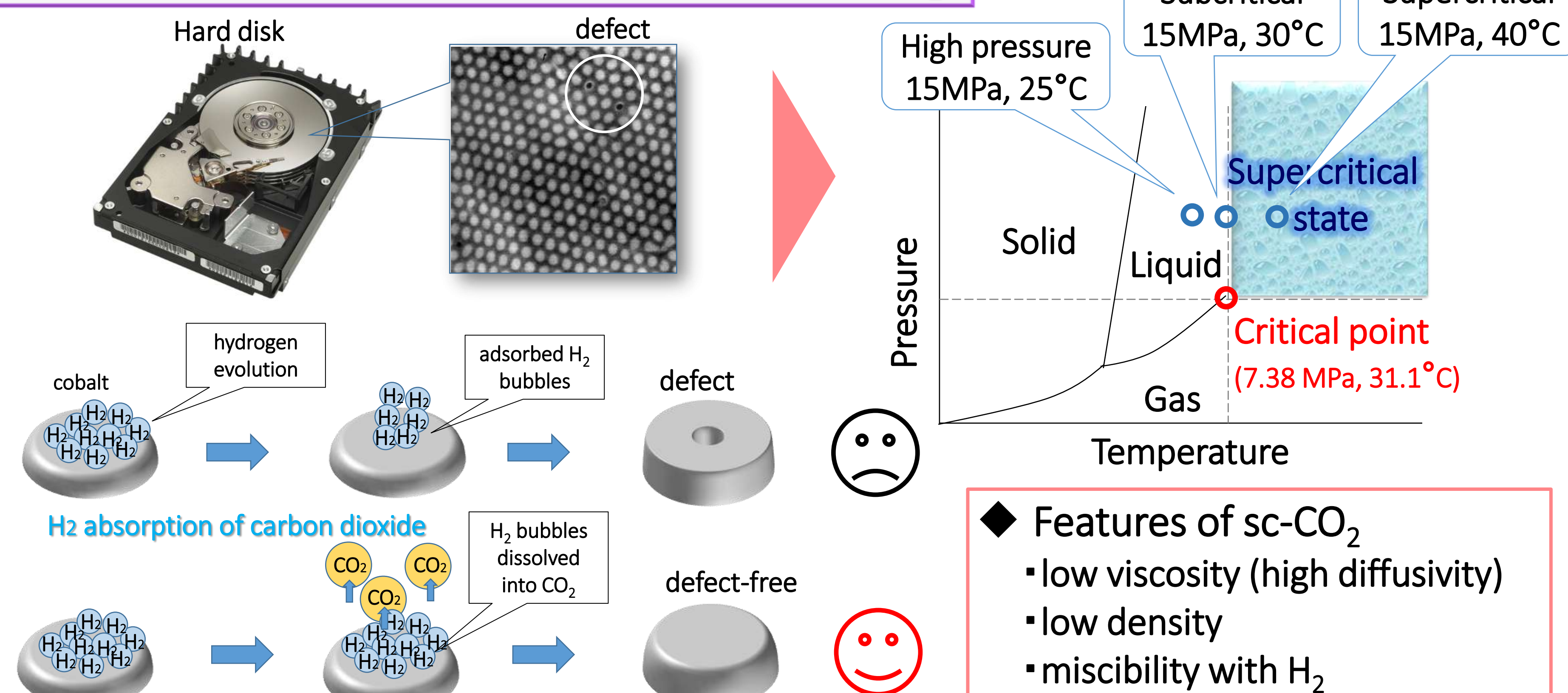
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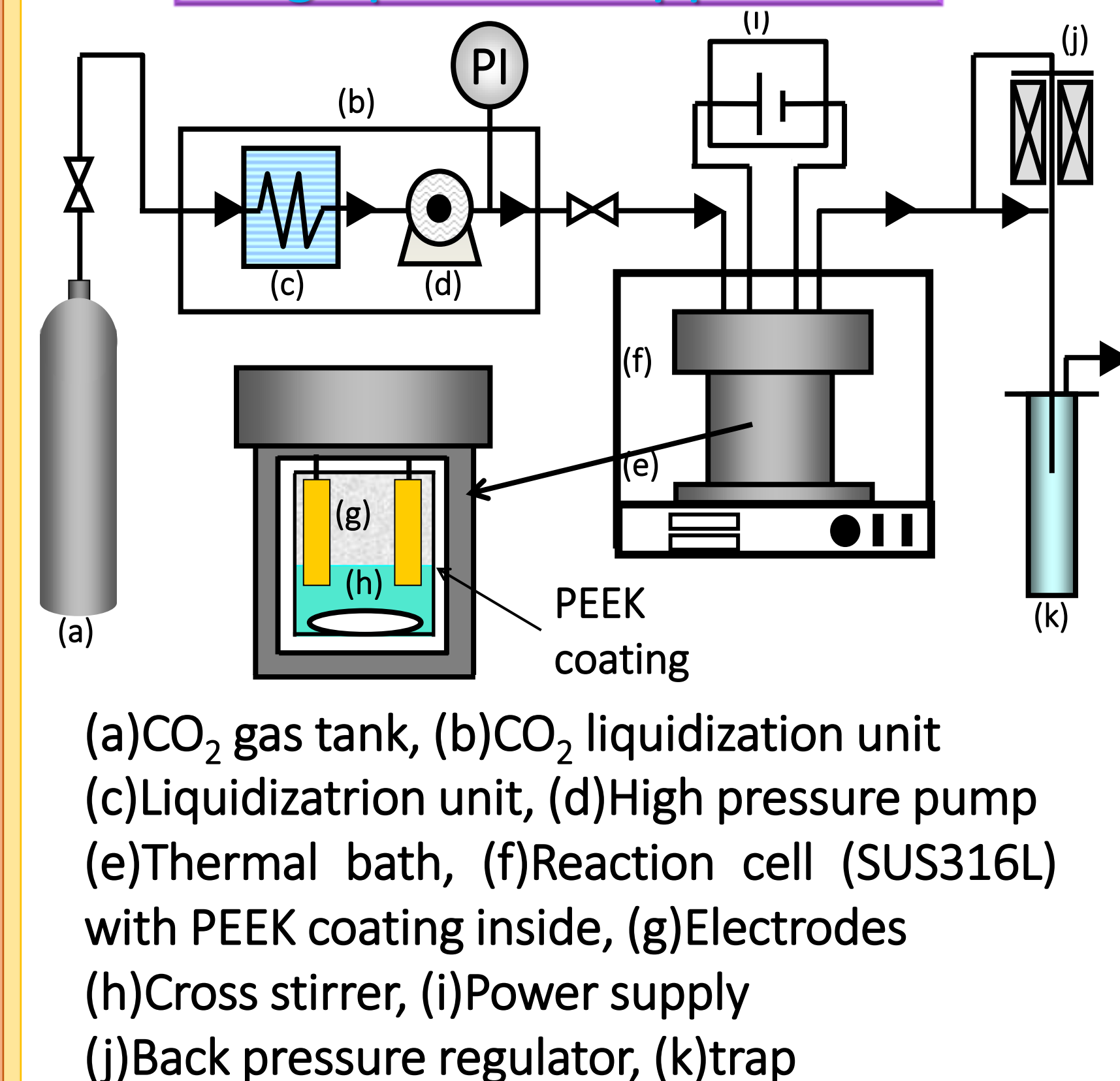
Introduction

Applications of Supercritical carbon dioxide (sc-CO₂)



Experimental details

High pressure apparatus



Materials

Electrodes

- Cathode : Cu
- Anode : Pt

Electrolyte

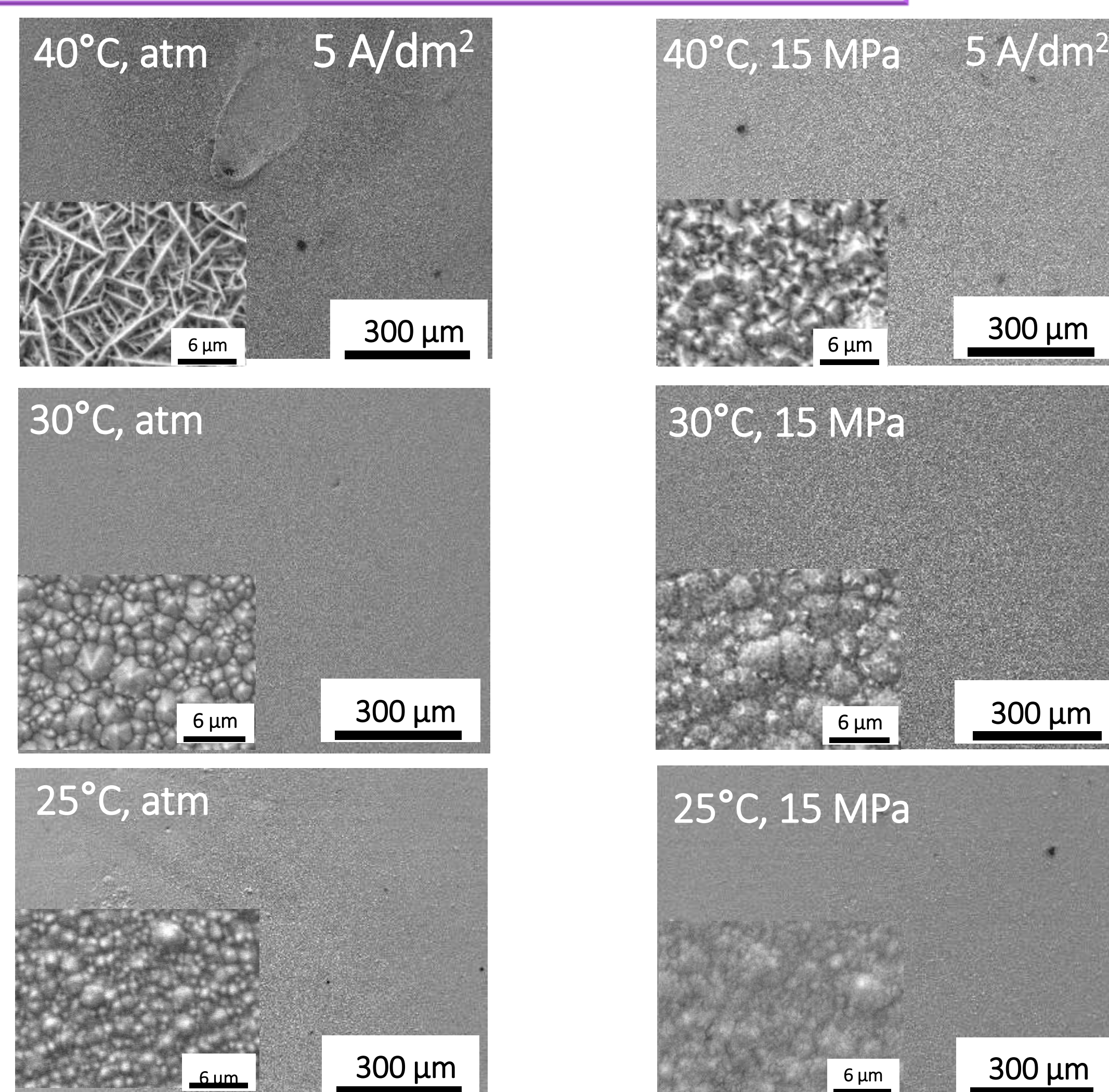
- CoSO₄·7H₂O (300 g/L)
- CoCl₂·6H₂O (45 g/L)
- H₃BO₃ (40 g/L)
- CO₂ (0 or 20 vol.%)
- Additive-free

Conditions

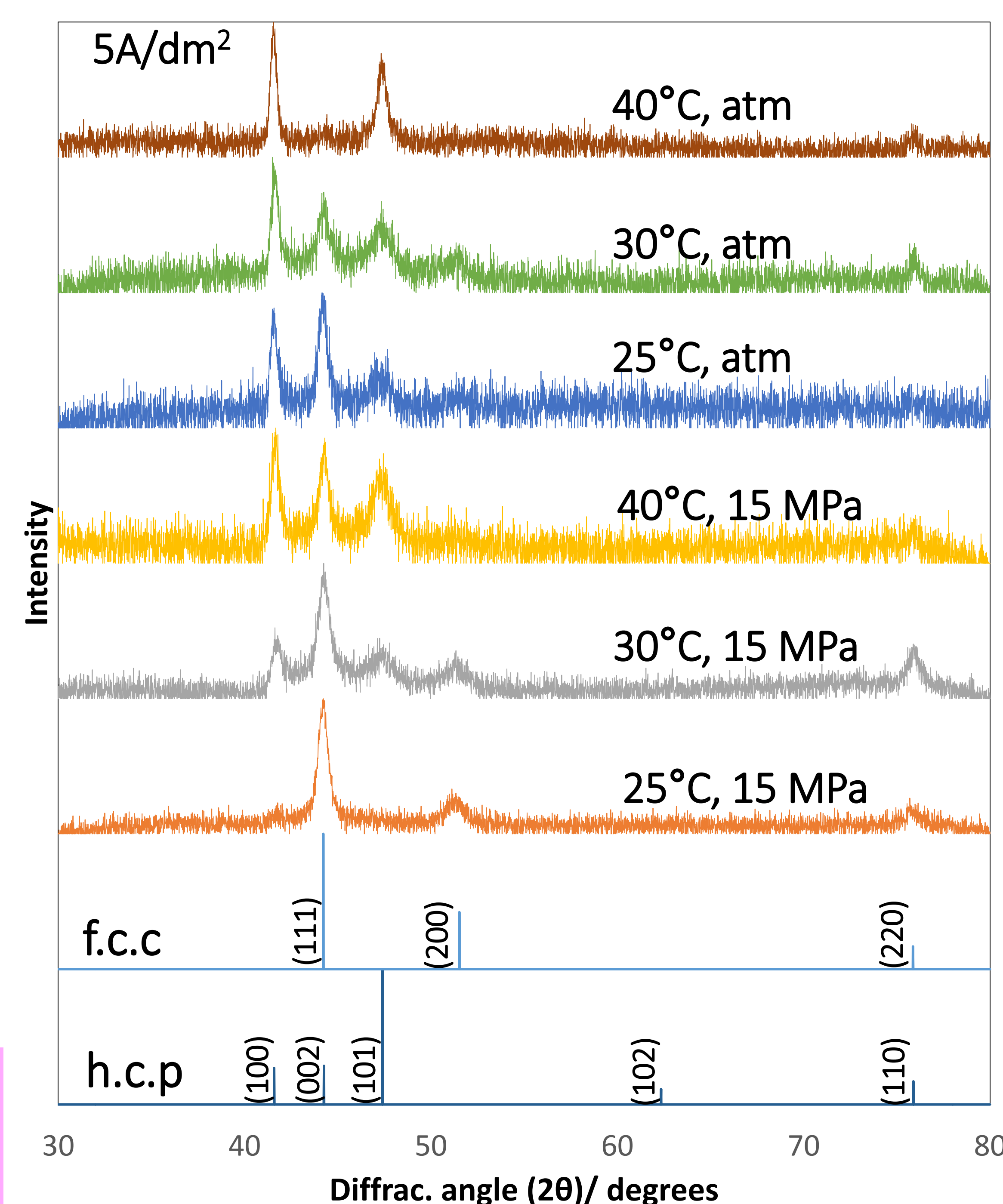
- Pressure : atmospheric pressure (atm)
15 MPa^[1] (high pressure, subcritical, or supercritical)
- Temperature : 25, 30, 40°C
- Current density : 5-15 A/dm²
- Charge : 288 C

Results and discussion

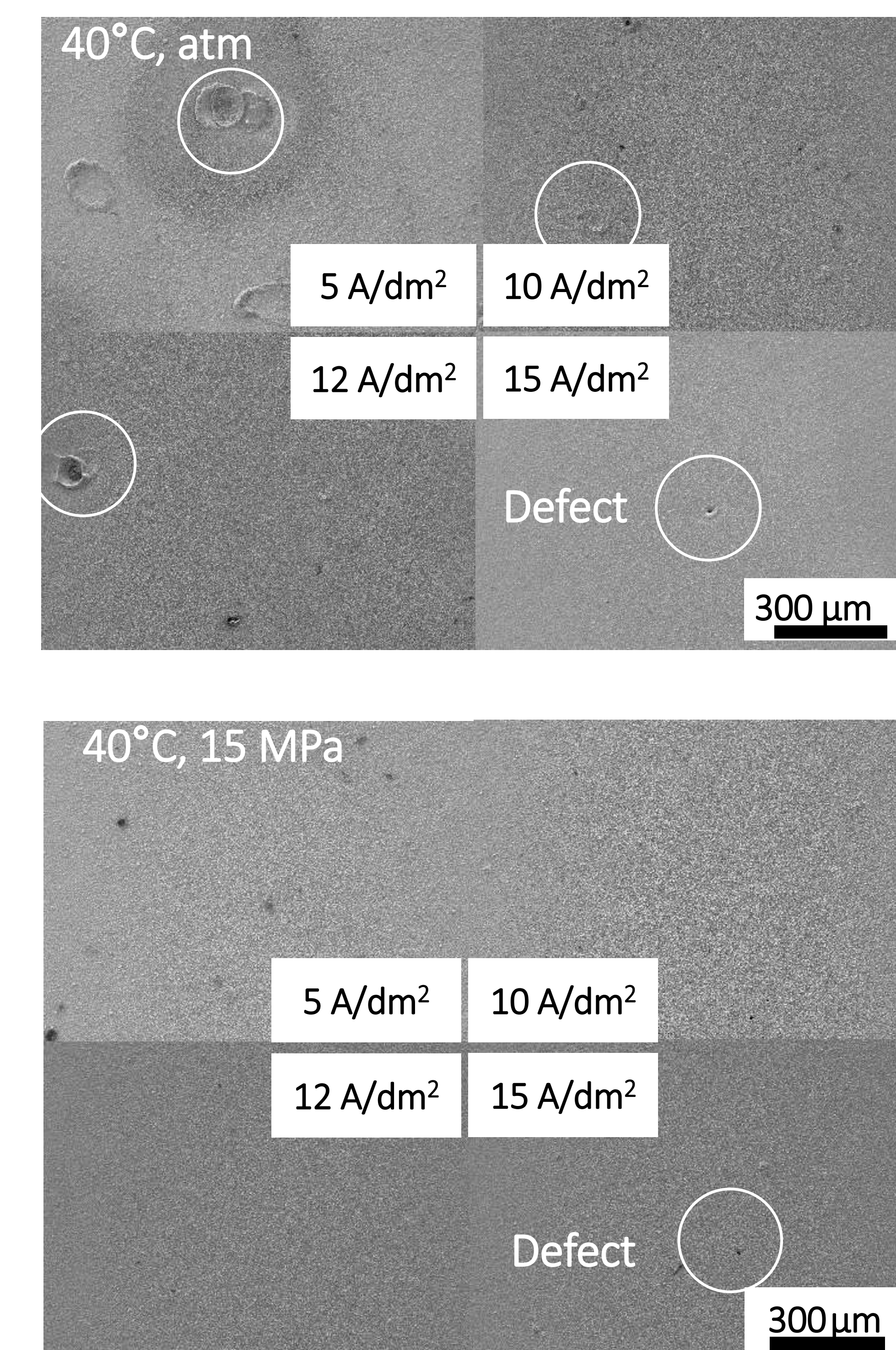
Morphology and XRD of cobalt films



- More h.c.p phases were obtained with an increase in current density.
- More f.c.c phases were obtained at 15 MPa.

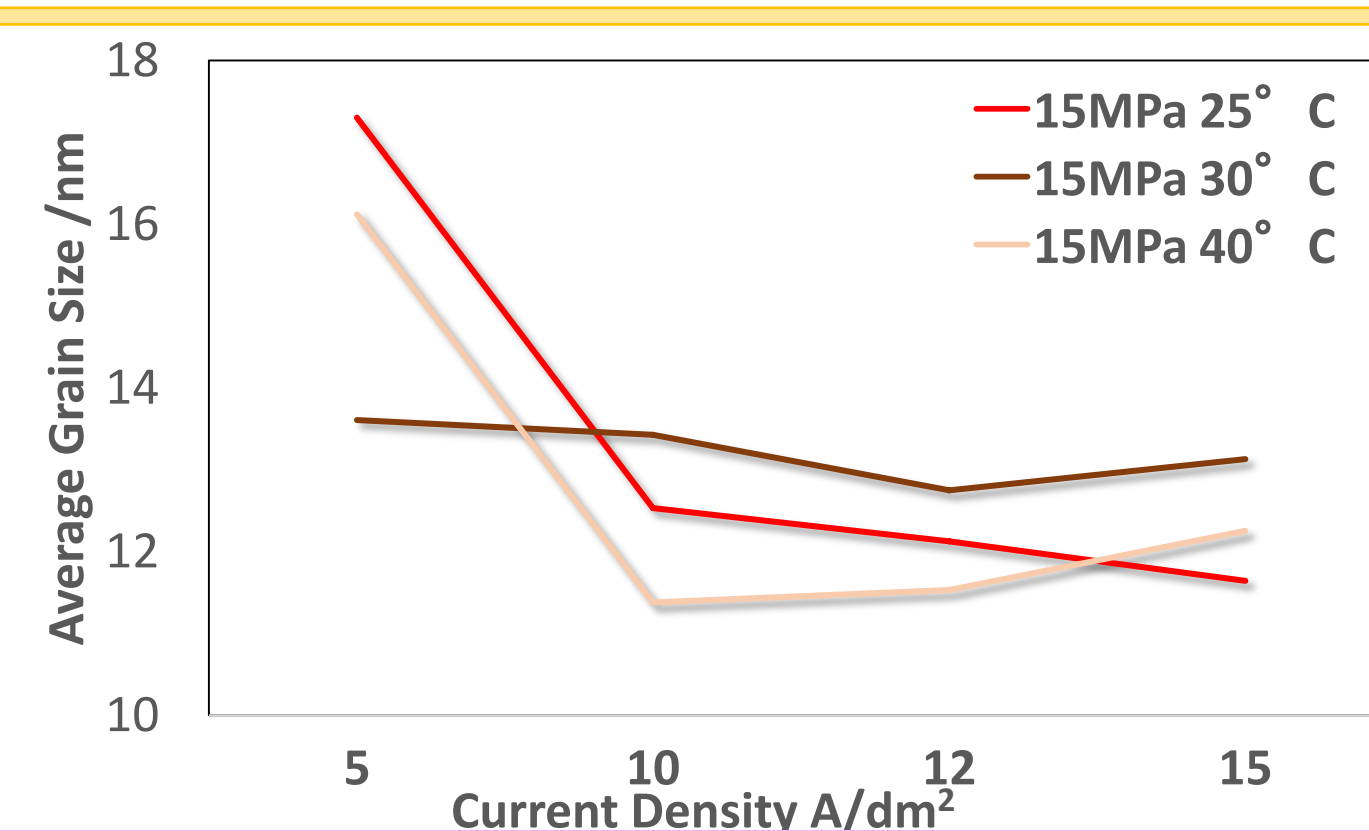
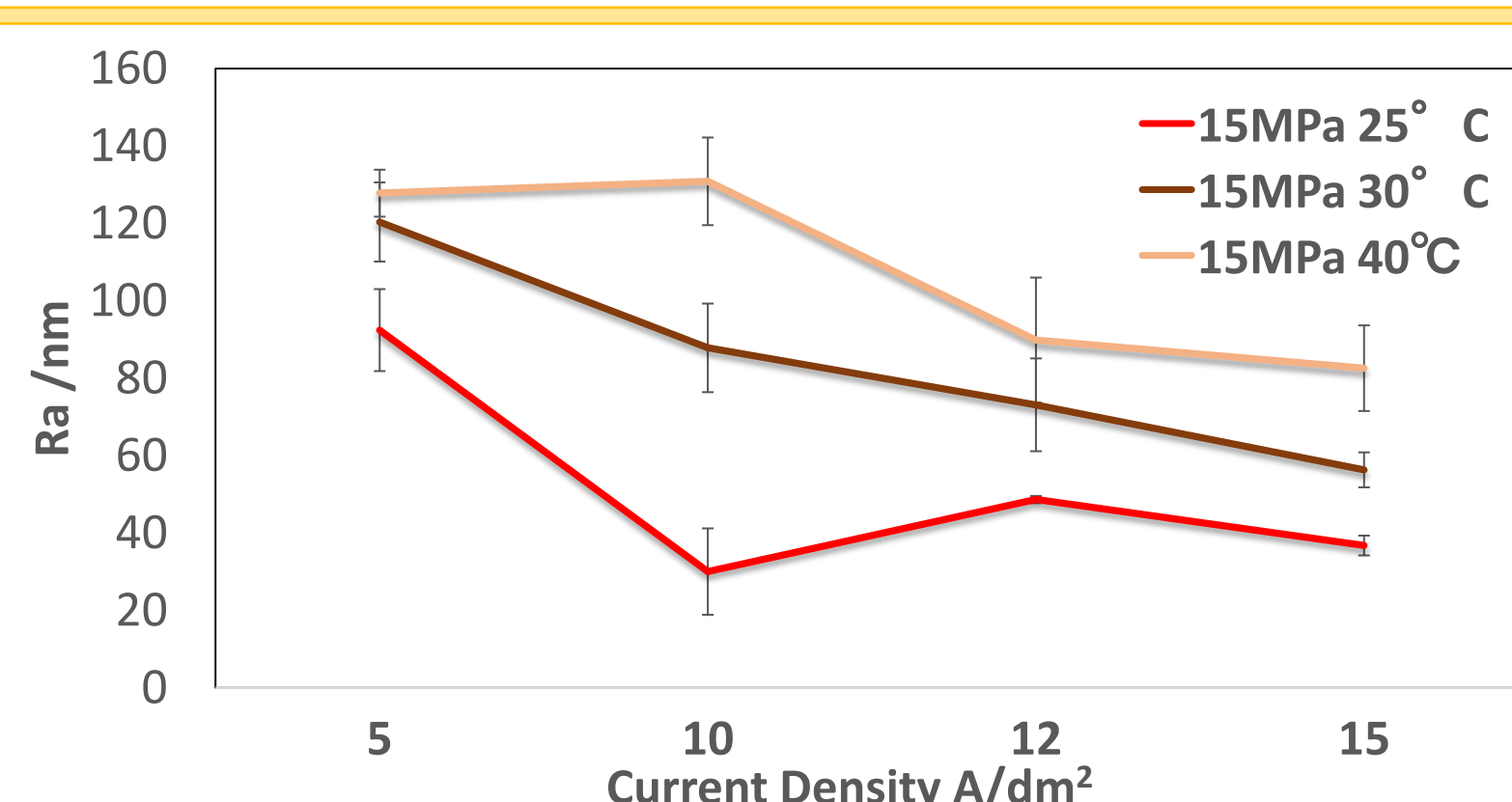


Morphology and defect



- Defect-free films were obtained with sc-CO₂ when current density is below 15 A/dm².
- Cobalt (III) oxide black^[2] was observed at low current densities.

R_a and Average grain size



Current Density ↑ = R_a ↓

T ↓ = R_a ↓

Current Density ↑ = Average Grain Size ↓

Conclusions

- More f.c.c phases were obtained at 15 MPa than at atm.
- Defect-free films were obtained with supercritical carbon dioxide below 15 A/dm².
- At 15 MPa, a decrease in temperature led to the decrease in R_a.

References

- [1] T.F.M. Chang, T. Shimizu, C. Ishiyama, M.Sone, Thin Solid Films. 529 (2013) 25-28
- [2] O. E. Kongstein, G. M. Haarberg, J. Thonstad, J. Electrochem. Soc., 158 (2011) D77-D83

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