113材料工程系大學部實習成果觀摩競賽

Electrodeposited Porous Copper Structures for Next-Generation Air-Cooled Two-Phase Heat Dissipation Technology

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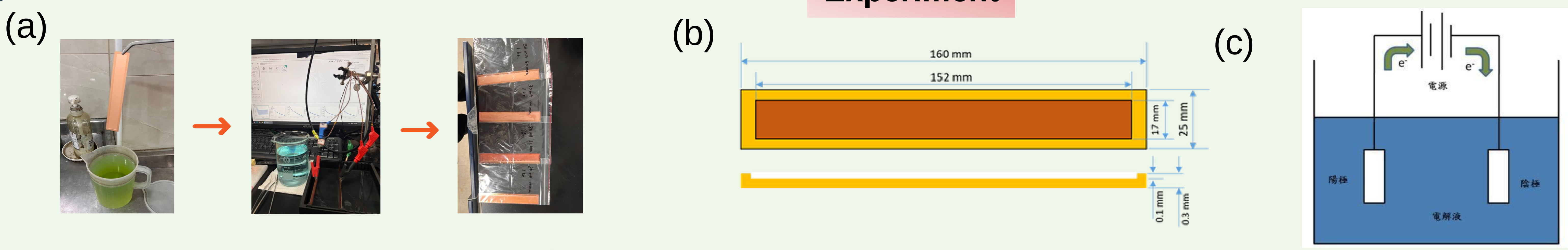
Abstract

This study investigates the process of preparing porous copper structures using electrochemical deposition and systematically examines the effects of various parameters on structural morphology. Key factors such as current density, pH value, deposition time, temperature, and additives were controlled in the experiments. Through scanning electron microscopy (Scanning Electron Microscope, SEM) , (X-ray photoelectron spectroscopy, XPS) characterization, we observed that these parameters significantly influence the formation and growth of porous structures. Results indicate that an electrolyte with a pH value of 2.3 produces optimal deposition effects. At a temperature of 60°C, the porous structure becomes more pronounced. Optimization of current density and deposition time is crucial for controlling the uniformity and density of the pore structure. Furthermore, the addition of PEG as an additive improves the flatness of the deposited layer. This research provides important guidance for preparing porous copper structures with controllable morphology, which have potential applications in fields such as catalysis and energy storage.

Experiment

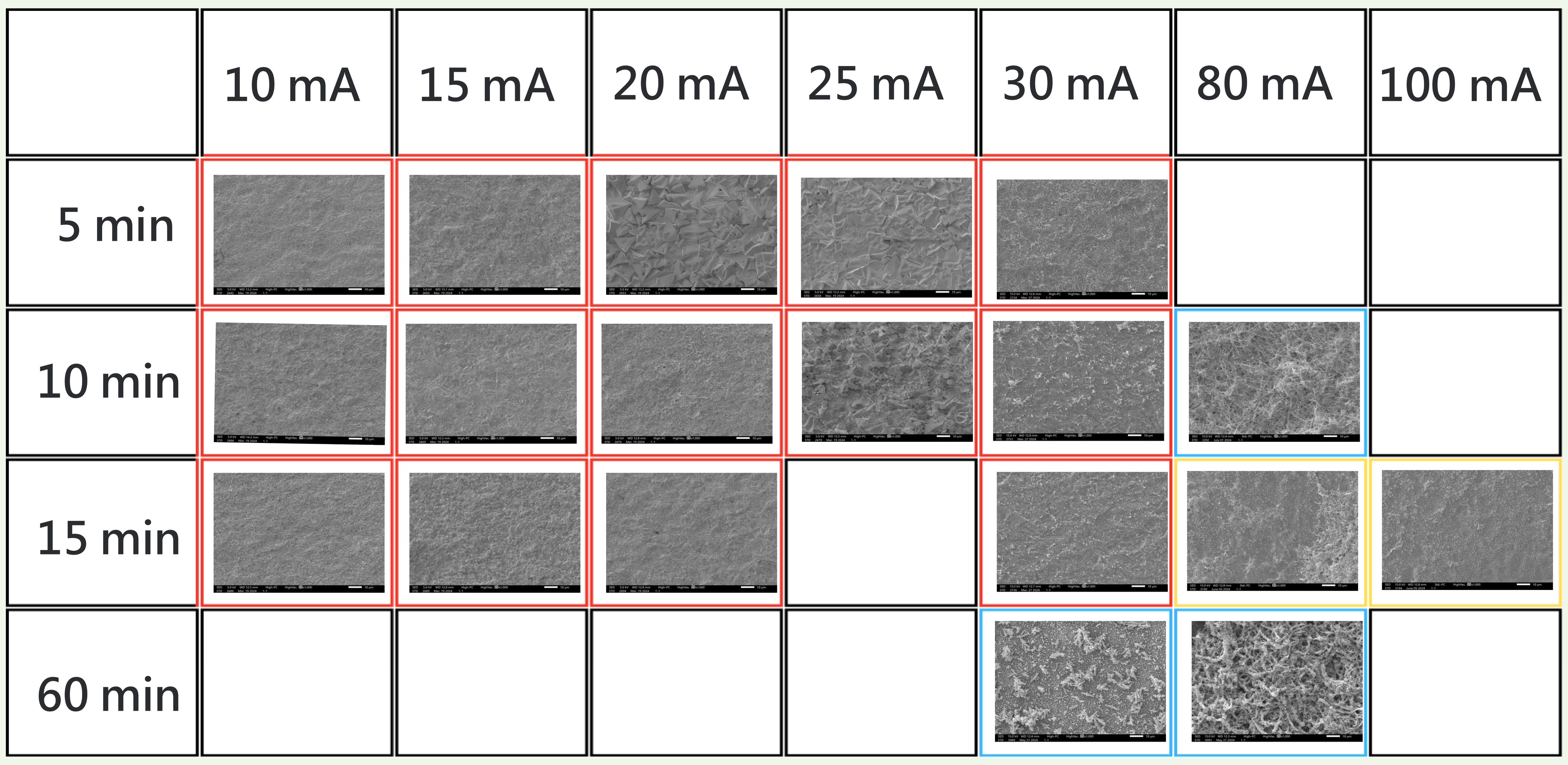


(a) Deposition flow chart and (b) Copper substrate size and (c) Deposition is intention

Characterization

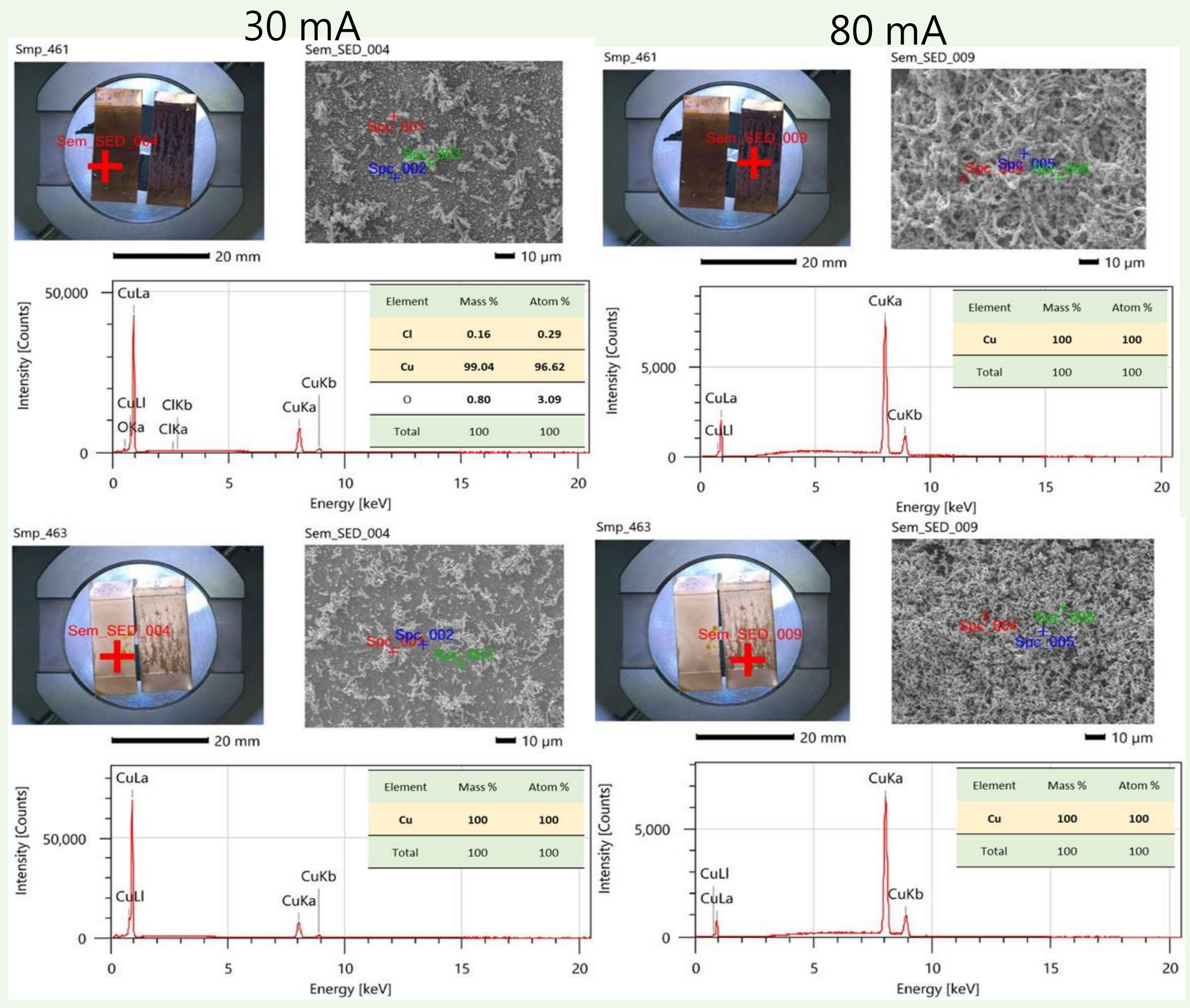
Different pH values: 0.3, 2.95, 2.3

Deposition distance：10 mm
Deposition temperature：Ambient temperature



It has been observed that a pH of 2.3 yields the best deposition results

Characterization

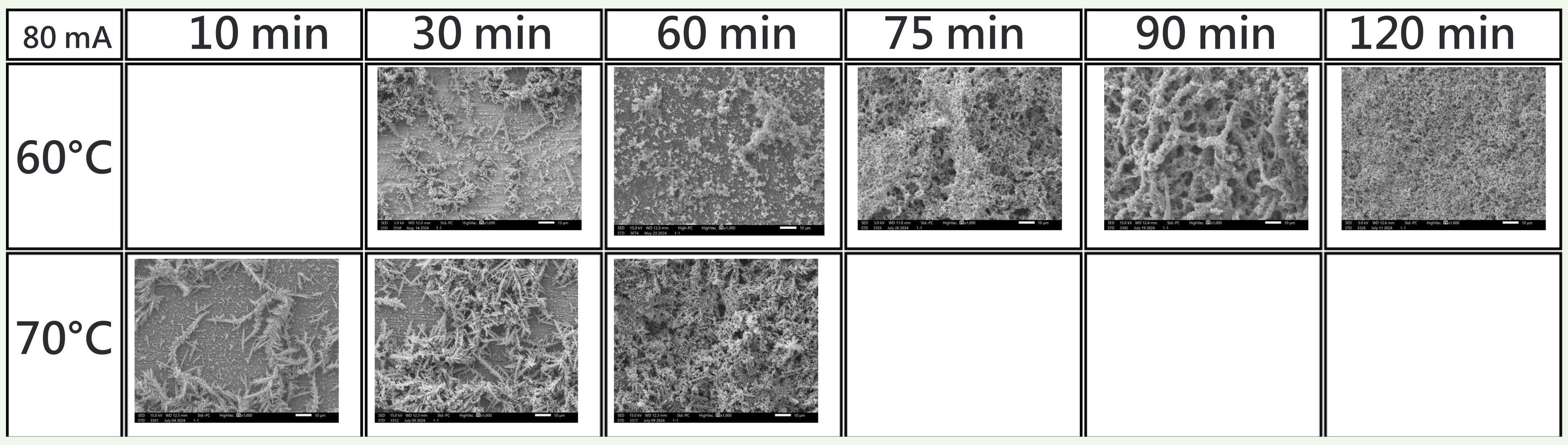


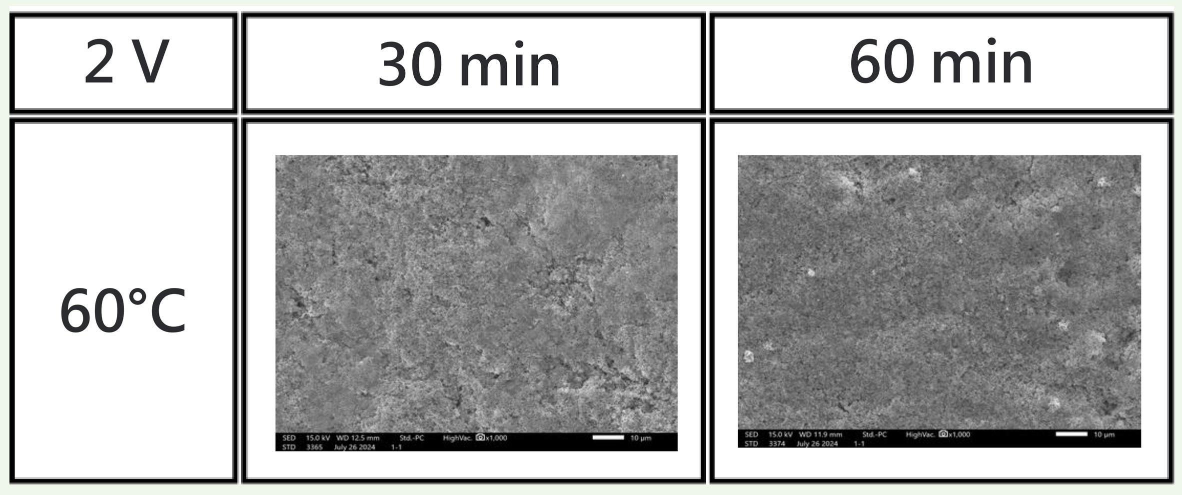
Different current densities and EDS before and after annealing

Characterization

Different deposition temperatures

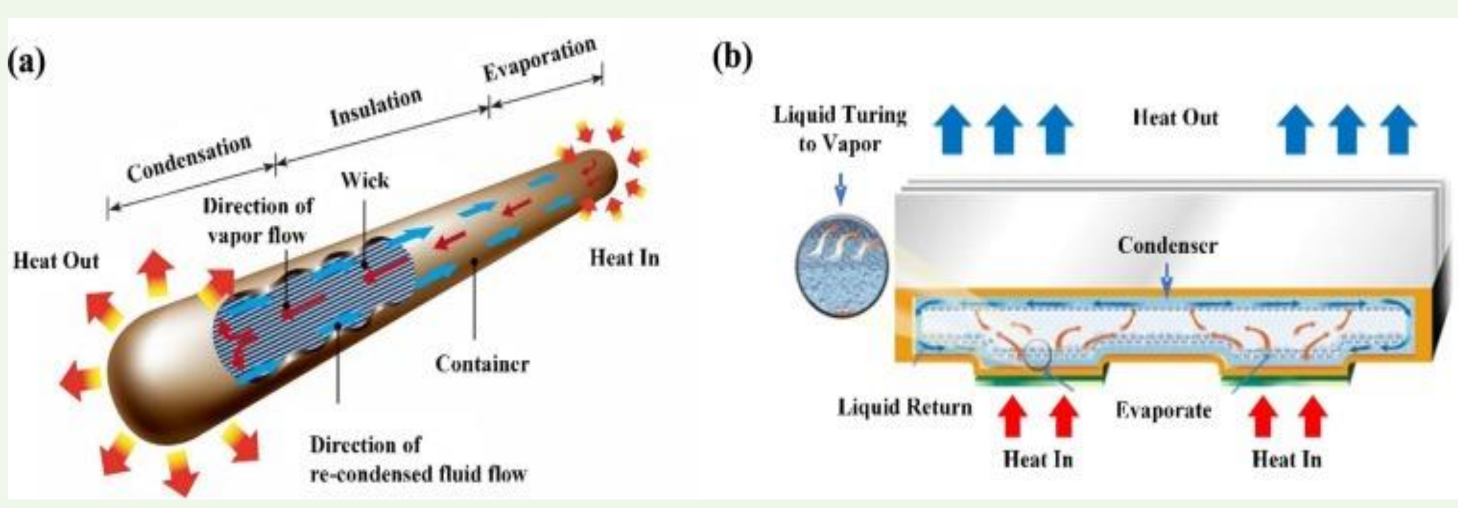
Deposition distance：10 mm
pH value: 2.3





Variation of constant current and constant voltage under different temperatures and times

Mechanism

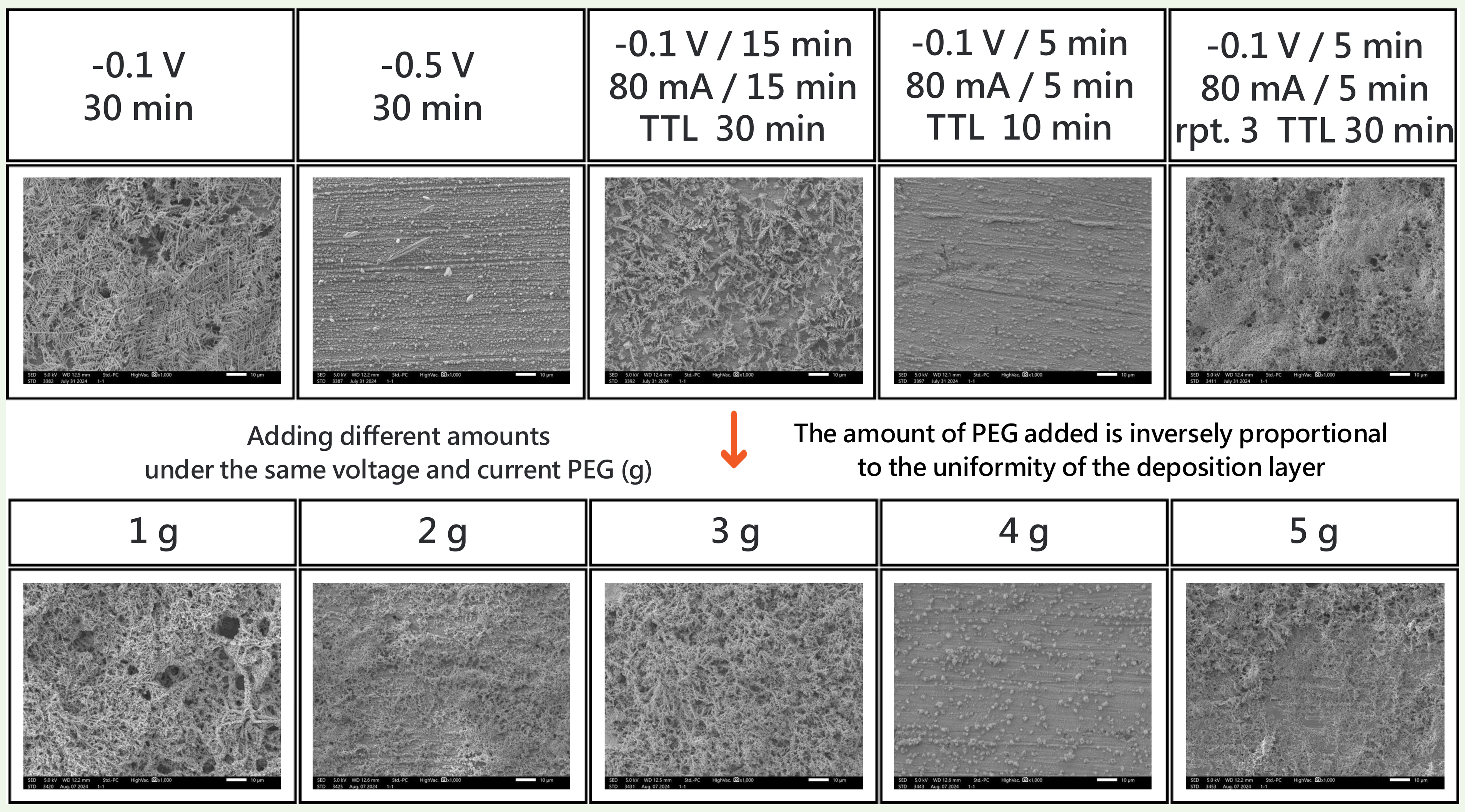


(a) Traditional cylindrical duct type heat pipe. (b) Flat heat pipe

Characterization

Alternating current, voltage, and the addition of different amounts of additives

Deposition distance：10 mm
pH value: 2.3



Conclusion

1. An acidic environment can corrode the substrate, while an alkaline environment is unsuitable for optimal copper deposition. A pH of 2.3 gives the best results.
2. At a bath temperature of 60°C, constant current creates a more porous deposition. Under the same temperature, constant voltage leads to overly dense deposition.
3. Adding PEG reduces the uniformity of the deposition layer; 1 to 3 grams of PEG is ideal

姓名：紀政賢　實習廠商：訊凱國際股份有限公司　指導主管：林華元
實習單位：兩相流暨先進材料　實習期間：112/09~113/09　輔導老師：謝建國

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