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Phase equilibria of Ag-Cu-Se-Te thermoelectric material

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Introduction

Thermoelectric have attracted a lot of research interests primarily because of their potentials in enhancing the energy usage efficiency. Phase diagrams provide fundamental information and are essential for materials understanding and development. The Ag-Cu-Se-Te quaternary system is important for thermoelectric materials. There are many high performance thermoelectric materials in this system, such as Cu_2Te , Ag_2Te , $\text{Ag}_2(\text{Te},\text{Se})$, AgCuTe , Ag_5Te_3 , and CuTe materials. The information of phase equilibria Ag-Cu-Se-Te is limited. Thus, the isothermal sections of Ag-Cu-Te at 600°C , 400°C and isothermal sections of Ag-Se-Te at 400°C , 250°C are carried out in this study.

Results

1. Ag-Cu-Te isothermal section at 600°C

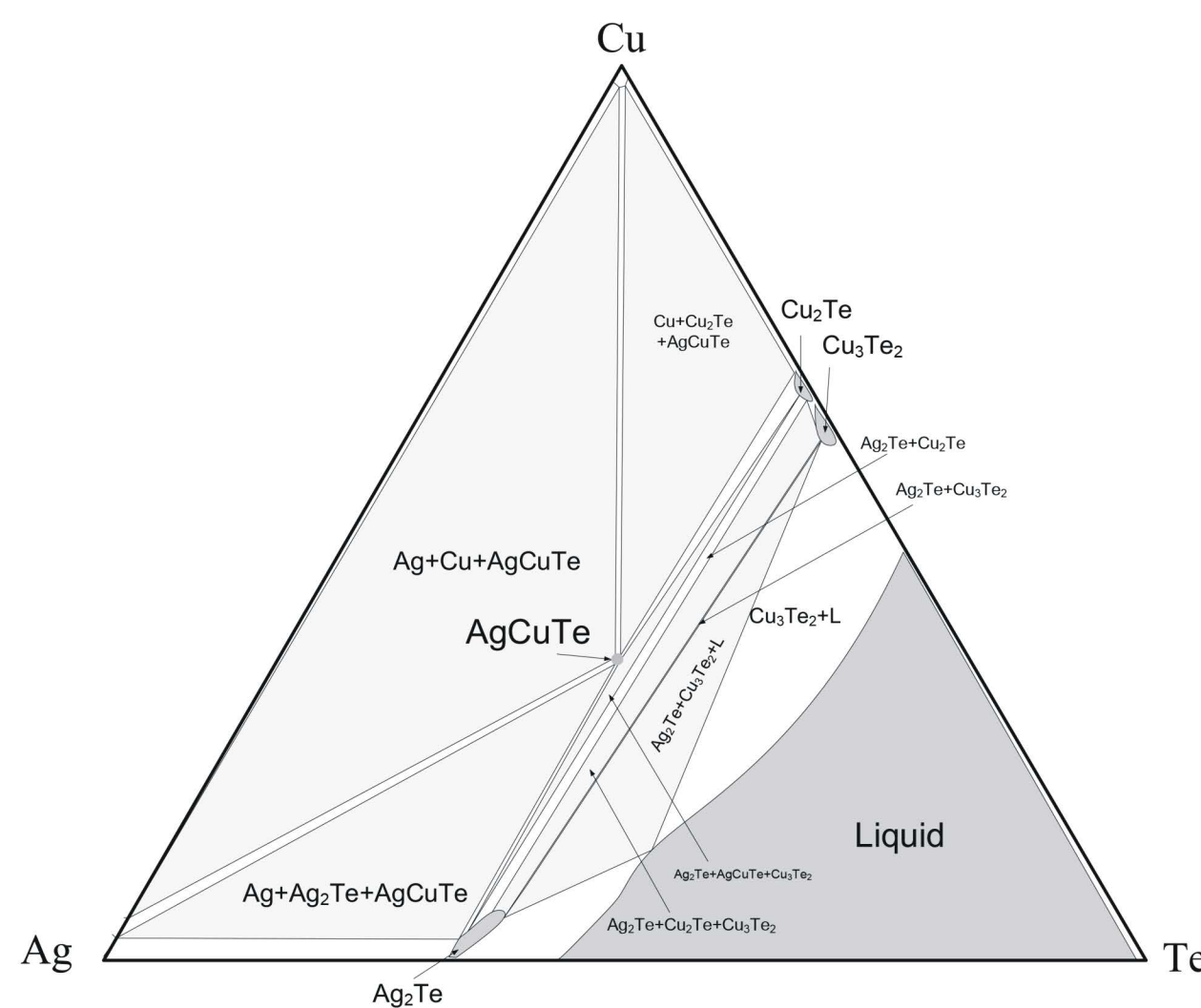


Fig.1: The determined isothermal section of Ag-Cu-Te ternary system at 600°C

The Ag-Cu-Te alloys were prepared and equilibrated at 600°C . The phase equilibria of those alloys were determined as shown in Fig. 1. There are six tie-triangles and one ternary compound of AgCuTe phase was found at 600°C .

2. Ag-Cu-Te isothermal section at 400°C

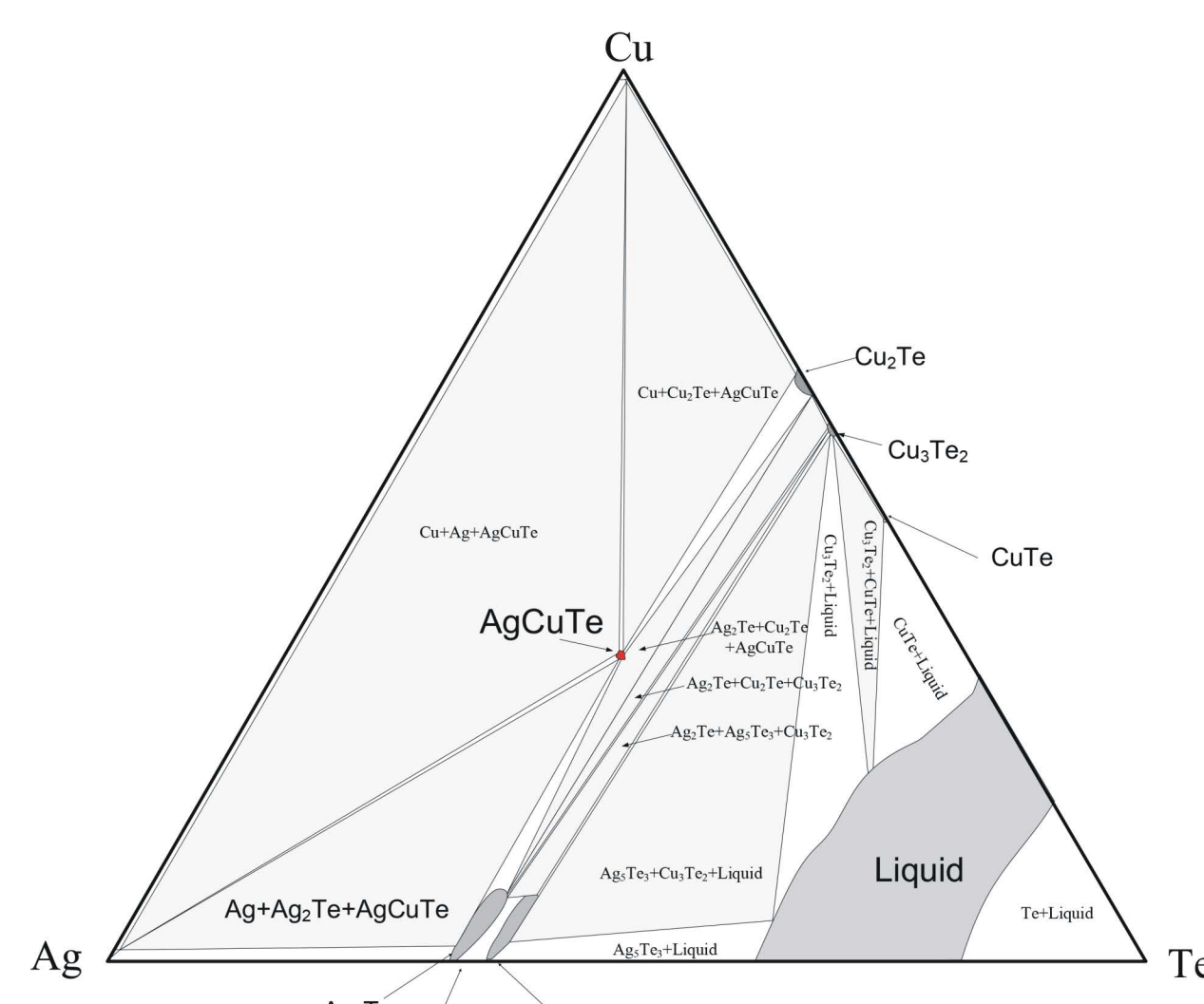


Fig.2: The determined isothermal section of Ag-Cu-Te ternary system at 400°C

The phase equilibria of Ag-Cu-Te alloys at 400°C were determined and shown in Fig. 2. There are eight tie-triangles and one ternary compound of AgCuTe phase was found at 400°C .

3. Ag-Se-Te isothermal section at 400°C

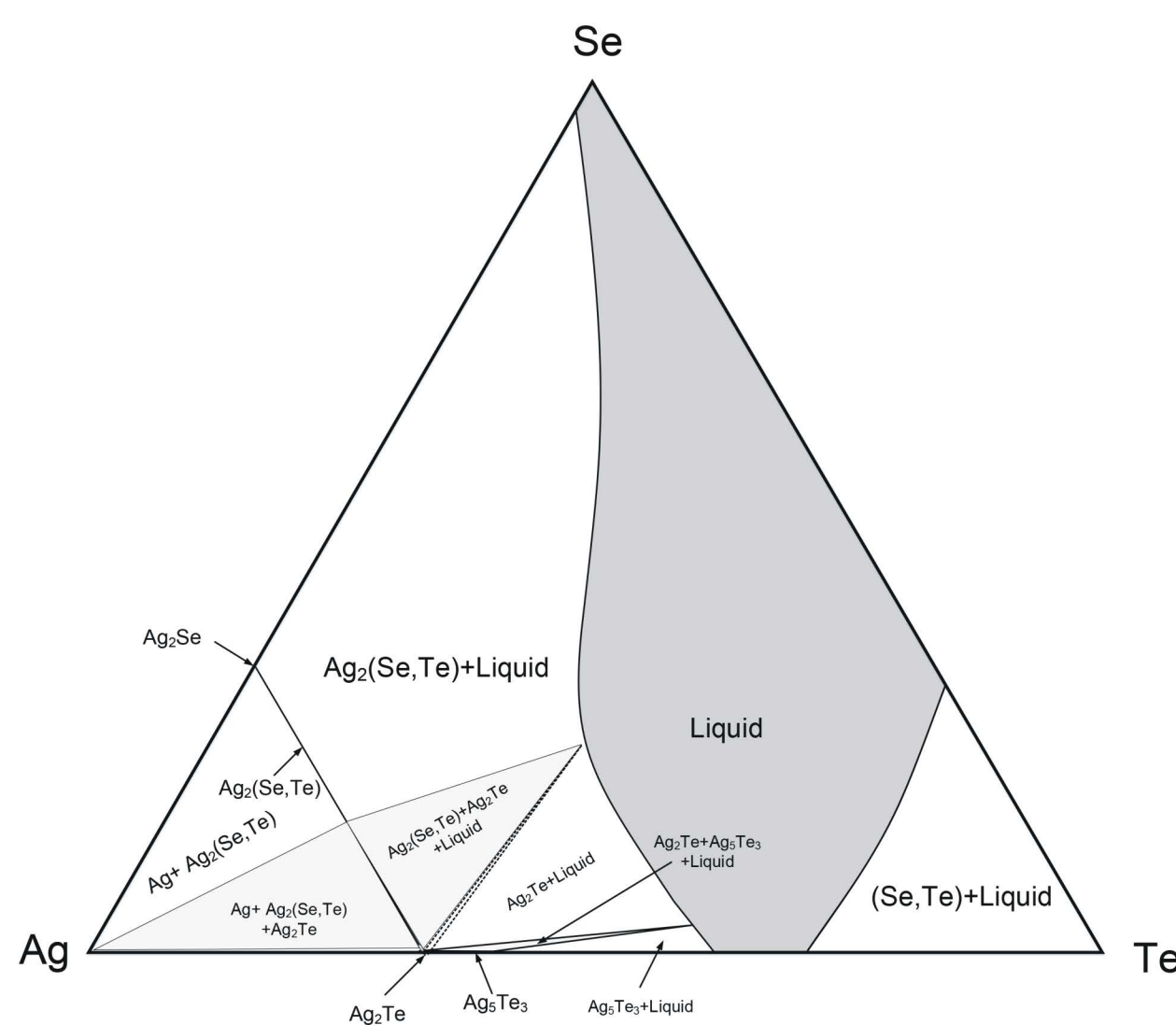


Fig.3: The determined isothermal section of Ag-Se-Te ternary system at 400°C

The isothermal section of Ag-Se-Te system was determined by analyzing the equilibrated alloys at 400°C . As shown in Fig. 3, there are three tie-triangles in isothermal section at 400°C . The two phase region along the $\text{Ag}_2\text{Se}-\text{Ag}_2\text{Te}$ is 52-88at% of Ag_2Te .

4. Ag-Se-Te isothermal section at 250°C

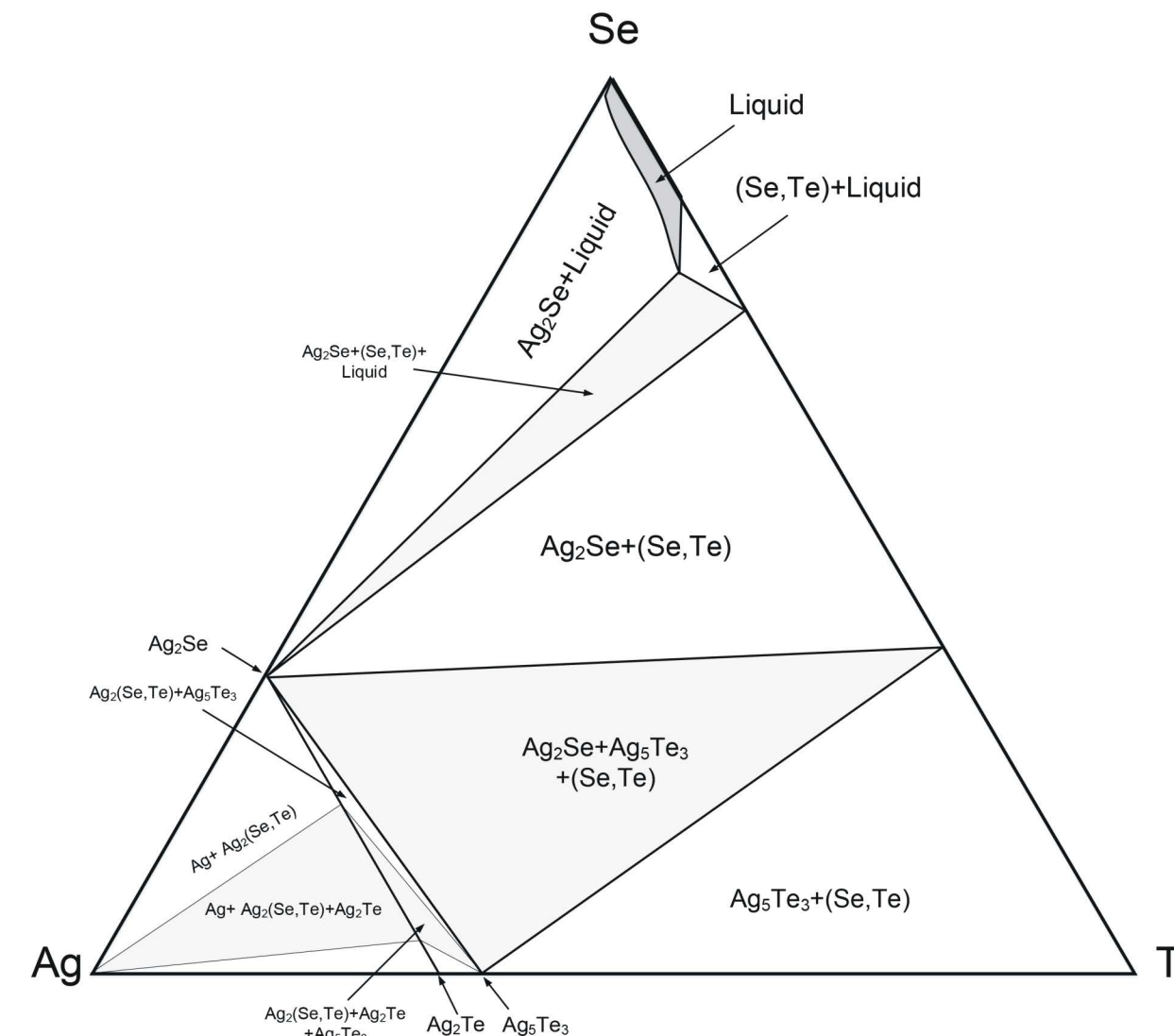


Fig.4: The determined isothermal section of Ag-Se-Te ternary system at 250°C

As shown in Fig. 4, there are four tie-triangles in isothermal section at 250°C . The two phase region along the $\text{Ag}_2\text{Se}-\text{Ag}_2\text{Te}$ is 41-85at% of Ag_2Te . A small liquid phase region is exist at the rich of Se side.

Acknowledgment

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Research experience

2016-2018: Master degree research project on Bi-In-Se system: (*Calphad Journal*. 68 (2020): 101744) and (*Journal of Alloys and Compounds* 779 (2019): 347-359). ChE NTHU.
2018-2019: Graduate assistant research in Institute of Physics in Academia Sinica
2019-now: PhD degree research assistant in ChE, NTHU.



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