MSI EUREKA | 通往无机材料的大门

iGroup · 上海

2019

提纲

一、MSI公司及产品介绍

二、MSI数据库客户端使用介绍

公司总览

产品——无机材料数据库

- 收集所有发行及出版的数据资料
- 数据整合：去除受争议及无用的数据
- 主题：相图、相反应、热力学

团队

- 1984年由来自全球的材料科学专家共同组成
- 收集&评估数据，补充缺失数据，测试新数据

公司

- 提供全球化的材料科学类服务
- 管理并推广产品

起源&发展

源于德国马普学会

- 1984年,一个材料科学家团队(MSIT)在德国马普学院进行金属研究；
- 1989 年MSI GmbH为MSIT提供研发条件；
- 今天，MSI与MSIT共同形成了世界上最大的材料领域的全球化研究网络。

MAX-PLANCK-GESELLSCHAFT

Dr Gunter Effenberg

- MSI的CEO和创立者；APDIC（国际合金相图委员会）的创始成员之一；担任过APDIC的主席；美国材料信息学会（ASM Internatioal）、 European Awards Committee的主席；德国材料学会的成员。

MSIT MATERIALS SCIENCE INTERNATIONAL TEAM

MSI EUREKA

by Scientists for Scientists!

一个全球化的协作团队

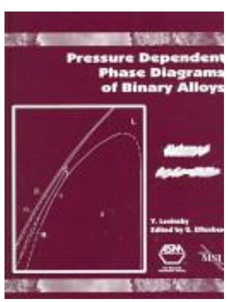
35年历史~250名材料科学家远程协作

- 监测所有相关出版物
- 评估二元&三元系数据
- 每年召开一次研讨会
- 开展合作项目

MSIT分布地点

GB	**Leeds; Sheffield; Manchester; Birmingham; Surrey**
DE	**Stuttgart; Clausthal; Aachen; Jülich; Freiberg**
NL	**Eindhoven**
FR	**Lille; Montpellier; Rennes; Paris; Grenoble; Lyon**
BE	**Leuven**
AT	**Vienna**
IT	**Genova**
GR	**Volos**
UA	**Kiev (Acad. Sci.); L'viv (Univ.); Chernivtsi; Kramatorsk**
RU	**Moscow (Acad. Sci.); State Univ.**
CN	**Changsha / Hunan; Central South Univ.; Bejing**
JP	**Tokyo (IT); Kyoto, Sendai**
Malaysia	**Sains Univ. Tronoh**
USA	**Cincinnati; Raleigh; Gainsville; Evanston; Gaithersburg**
BR	**Campinas; Lorena; Sao Paulo, IPT; PUC Rio**
South Africa	**Witwatersrand**
India	**Chennai, Bhabha Atom. Center (Mumbai)**

MSI & MSIT出版物



- “Ternary Alloys”(三元合金)丛书，全18卷

  对材料体系的严格评估；铝、银、砷、锂、镁三元系相图；曾与Wiley出版社共同出版，后由MSI独立出版

- Landolt-Börnstein(简称LB工具书)子系列“Ternary Alloys Phase Diagrams”(三元合金相图)，全17卷

  对材料体系的严格评估；与Springer出版社共同出版

- “Red Book” 系列:"Phase Diagrams of Metallic Systems"丛书，全18卷

  原由前苏联科学院出版，出版全球相图相关文献的标准摘要，报道前一年的科学进展。年鉴，因封面总是红色而得名;现与俄罗斯国家科学技术信息研究所(VINITI)共同出版，现只有网络版

- “Metal-Boron-Carbide”

  作者：Peter Rogl, 由MSI编辑，并与美国材料信息学会(ASM)共同出版

- “Pressure Dependent Binary Phase Diagrams”

  作者： Yuri Lewinski,由MSI编辑，并与美国材料信息学会(ASM)共同出版

主题: Phase Transformations（相的转化）

- 材料性质会因其相变而受影响
- 相会因温度、压力或材料成分的改变而变化

因温度变化

温度升高将固相（雪）转化为液相

因压力而变化

冰鞋产生的压力将固体(冰)转化为液体。滑冰者实际上实在一层水膜上滑行。

因成份而变化

在雪地上撒盐(冰+氯化钠)以降低溶点。冰转化为液体。

- 科学家从**相图**中了解这些相变
- 就在 MSI EUREKA

MSI Eureka——数值/工具型数据库

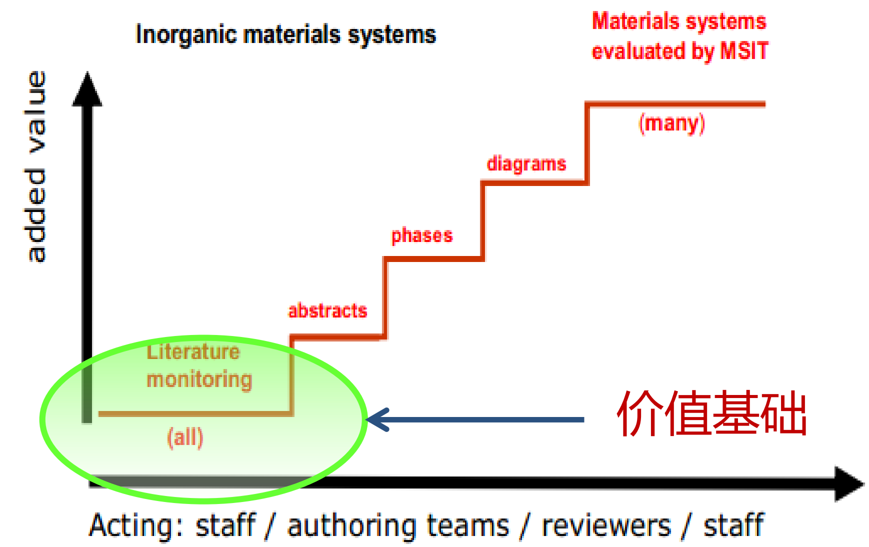
MSI Eureka持续关注无机材料的全球出版物，并汇编1894年以来一元、二元、三元及多元系统的相图及其相关数据等。提供：

- 评估已发表数据
- 整合分散的数据
- 相图、微观结构图、性质、热力学数据
- 帮助了解材料

MSI Eureka内容简介

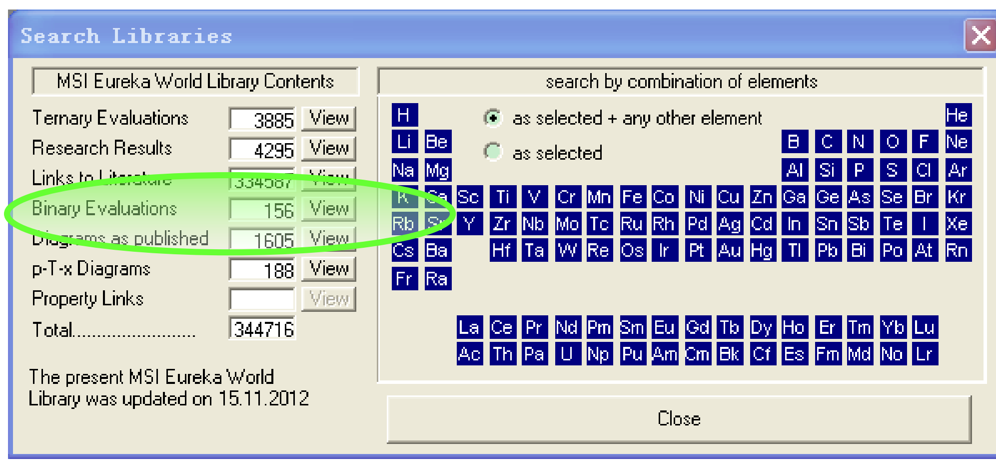
数据汇编

- 文献---由MSIT编辑
  - 收录的书目数据~448,000条
  - 所有出版过的无机材料体系~71,000个(不含无机盐)
- 评估报告
  - 三元系~4000个，二元系245个，单元体系188个
- 参考相图
  - 1900张相图，含1600个二元及三元体系



特色

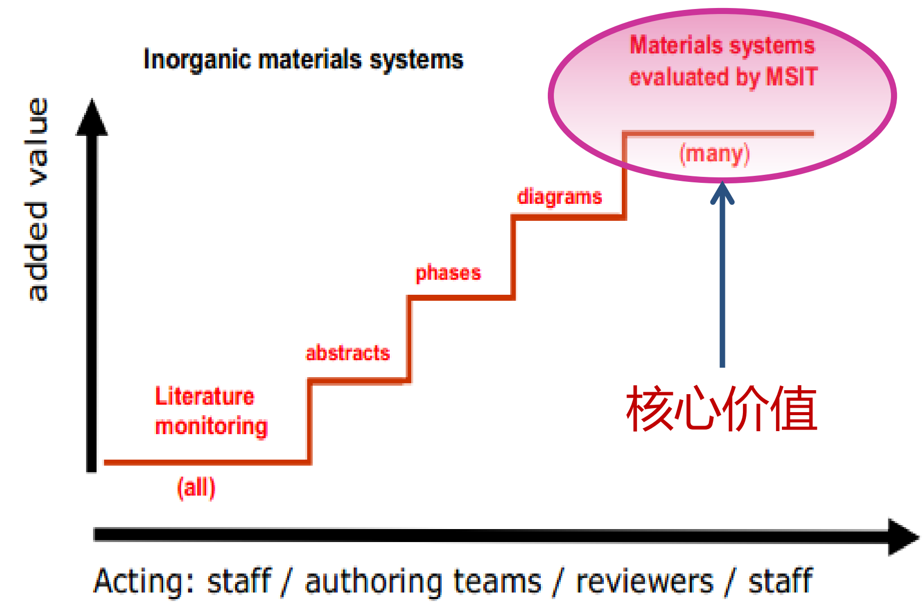
- 同行评议：经材料工作者们多次验证
- 材料齐全，参考文献范围广泛
- 界面简洁方便，搜索结果高度匹配
- 个性化服务功能



MSI Eureka内容简介

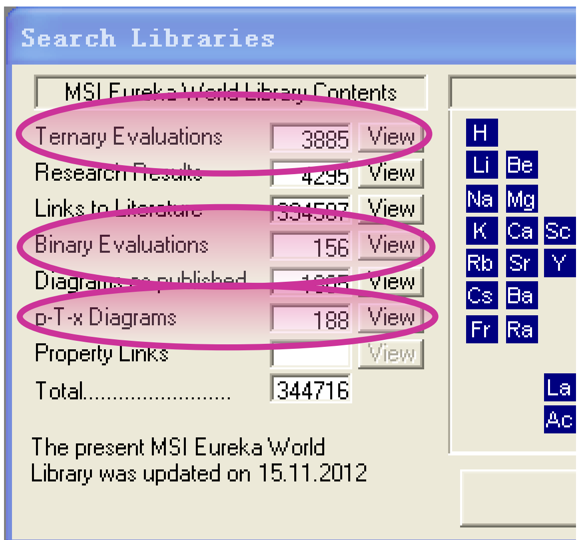
数据评估---严格测试过的材料体系

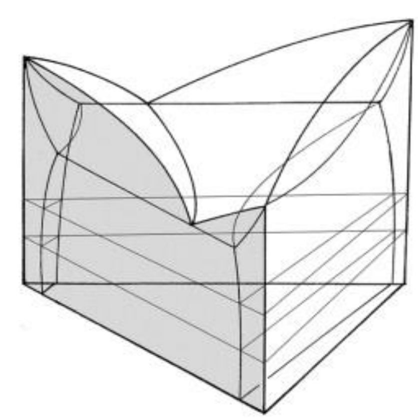
- 三元系：~4000个
- 二元系：245个
- p-T-x：188个压力/温度数据



特色

- 将所有出版物及描述汇集一体
- 评估 & 证实实验结果
- 检查数据的一致性并对其进行解释
- 指出并解决争议或矛盾数据
- 囊括非公开发表数据
- 将数据整合到相图中





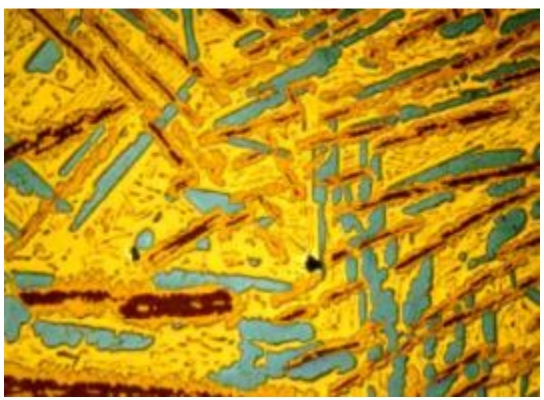
材料范围

材料种类

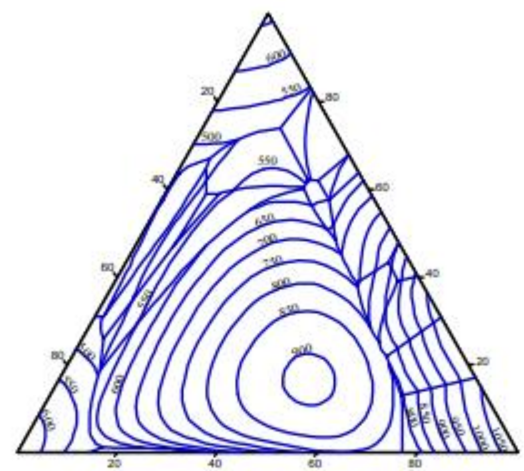
- 合金: 钢铁,铜合金,磁铁,电子材料…
- 非金属: 陶瓷,半导体,传感器…
- 复合材料: 金属陶瓷…

固相范围内的相及相反应

微观物相图



多重物相，Ag-Cu-Sn三元系



等温相图，材料研究者的地图

材料范围

<table>
<tr><td>铝合金</td><td>Al*</td><td>铜合金</td><td>Cu*</td></tr>
<tr><td>钢及铁合金</td><td>Fe*</td><td>稀土金属</td><td>Sc*, Y*, La*, Lanthanoids*</td></tr>
<tr><td>耐热合金</td><td>Ni*, Co*</td><td rowspan="2">硬质合金</td><td rowspan="2">W-C*, W-C-Co*, W-C-Cr*, W-C-Ni*, W-C-Nb*</td></tr>
<tr><td>轻金属合金</td><td>Al*, Ti*, Mg*, Be*, Li*</td></tr>
<tr><td>硼化物陶瓷碳氮合金</td><td>B*, C*, N*</td><td>高熔点金属及其合金</td><td>Cr*, V*, W*, Nb*, Hf*, Zr*, Ta*, Mo*, Re*</td></tr>
<tr><td>锂离子电池</td><td>Li*, P*, Co*, Mn*, Ni*, Cu-Sn*, Ti-Si*, C-Si*, Mo-S*</td><td>贵重金属</td><td>Ag*, Au*, Pd*, Pt*, Rh*, Ru*, Ir*, Os*</td></tr>
<tr><td>焊接材料</td><td>Ag*, Au*, Bi*, Cu*, In*, Sb*, Sn*, Zn*, Pb*</td><td rowspan="2">半导体材料</td><td rowspan="2">Si*, Ge*, As*, N*, Ga*, Cd*, Te*, Se*, S*,Sb*, P*, In*, Cl*, I*, Br*, Zn-O*, Ti-O*, Cu-O*,U-O*, Bi-O*, La-O*, Fe-O*, Ni-O*, Eu-O*</td></tr>
<tr><td>核材料</td><td>Actinoids*, Cs*, O*, Zr*, Fr*, Ra*, Po*, At*,Rn*, Sr*, Xe*, H*, Ac*, Rf*, Sg*</td></tr>
</table>

*：代表与其它元素组成的体系，如Al*代表Al与其它元素组成的体系

目标客户

- 科学家&工程师：学术界&企业界；科研专家；教育工作者&大学生
- 数据管理者：图书管理员；资讯专员
- 科学管理：项目经理；工程管理人员

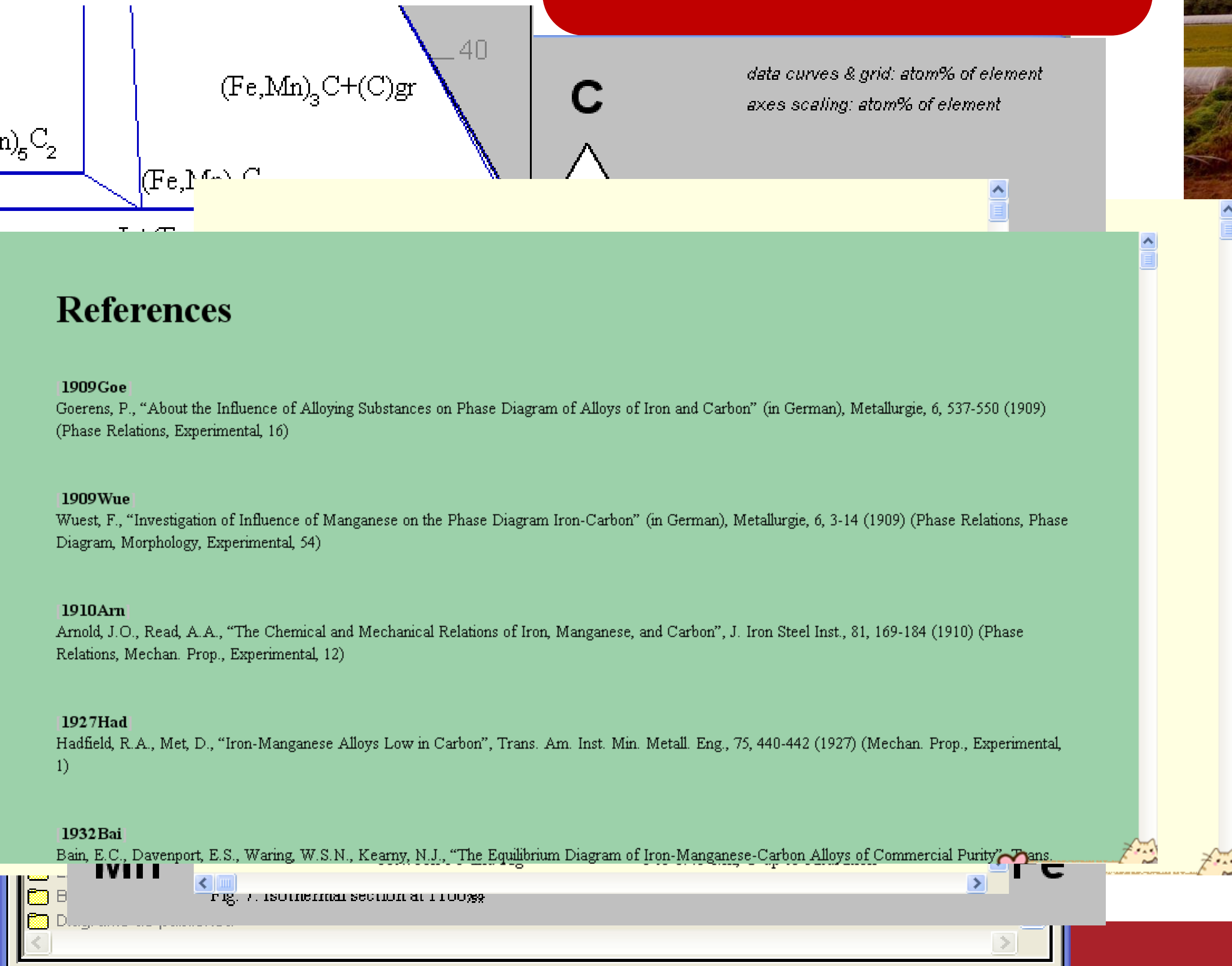
学科领域

- 化学
- 物理
- 工程
- 材料学，包括材料设计
- 晶体学，晶体生长等
- 热力学
- 合金开发及设计
- 其他

- 为多种工业提供基本信息，包括自动化、航空航天，重工业，制造业，能源循环...
- 功能材料，传感器...
- 结构材料
- 金属，陶瓷，陶瓷合金
- 其它

使用案例

高铁铁轨需要高硬度、韧性、耐磨性的钢材料，如Fe-C-Mn体系+V+Cr



References

1909Goe
Goerens, P., "About the Influence of Alloying Substances on Phase Diagram of Alloys of Iron and Carbon" (in German), Metallurgie, 6, 537-550 (1909) (Phase Relations, Experimental, 16)

1909Wue
Wuest, F., "Investigation of Influence of Manganese on the Phase Diagram Iron-Carbon" (in German), Metallurgie, 6, 3-14 (1909) (Phase Relations, Phase Diagram, Morphology, Experimental, 54)

1910Arn
Arnold, J.O., Read, A.A., "The Chemical and Mechanical Relations of Iron, Manganese, and Carbon", J. Iron Steel Inst., 81, 169-184 (1910) (Phase Relations, Mechan. Prop., Experimental, 12)

1927Had
Hadfield, R.A., Met, D., "Iron-Manganese Alloys Low in Carbon", Trans. Am. Inst. Min. Metall. Eng., 75, 440-442 (1927) (Mechan. Prop., Experimental, 1)

1932Bai
Bain, E.C., Davenport, E.S., Waring, W.S.N., Kearny, N.J., "The Equilibrium Diagram of Iron-Manganese-Carbon Alloys of Commercial Purity", Trans.

利用MSI设计新材料
1.提供相关或相似体系材料的热力学参数；
2.参考相似的研究方法，节约时间 & 资源

使用案例

制定材料的生产工艺或检测标准，如 Fe-C-Mn

Table 1: Recent Investigations of the C-Fe-Mn Phase Relations, Stru

Reference	Method / Experimental Technique	Temperature/Composition/ Phase Range Studied
[1989Dre]	C activity from equilibration of liquid with MnO containing slag and with CO containing gas phase	1400 to 1800°C, 70 and 80 mass% Mn, to 8 mass% C
[1990Ni1] [1990Ni2]	C solubility in melts	1400 and 1500°C, 0 to ~9 mass% Mn
[1990Put]	Metallography, XRD	827°C, 5 and 6 GPa, 70 to 100 at.% C
[1993Wit]	C partial enthalpy, enthalpy of formation, isoperibolic calorimetry	1627°C, 0 to 100% Mn, C up to saturation
[1994Prz]	C activities by equilibration with gas phase	900°C, to 1.55% C, 1.7% Mn
[1995Eno]	Mn activities by distribution between Fe and Ag	1463, 1500 and 1550°C, 0 to 0.45 Mn, C up to saturation

利用MSI查找材料参数

1.提供最可靠的匹配参数，减少实验数量；

2.检测所得材料的性能是否合格；

3.为新项目的申请提供研究现状、可行性研究

我们的优势

- **同行评议**：所有数据均经过材料工作者们的多次验证；
- **材料齐全，参考文献范围广泛**：
  71,000个无机材料体系，1894年至今的250种期刊及灰色文献
- **界面简洁方便，搜索结果高度匹配**：
  互动式元素周期表搜索方式
- **个性化服务功能**：动态、交互式图片，可放大、重叠显示和检索图片

访问方式

- 客户端下载:
  http://www.msiport.com/discover-msi-eureka/how-to-access-msi-eureka/eureka-viewer/download-installation/

- 网页访问:
  https://search.msi-eureka.com/search

客户赞誉

以前我们要在检索多个书目数据库上花费大量的时间。自从2000年开始使用MSIT Phase Diagram Center（MSIT相图数据库，EUREKA的前身），做同样的工作只花几分钟的时间。节省的时间已是物有所值，而且我们非常感激三元系相图数据的卓越品质。

Prof. R. Schmid-Fetzer
德国克劳斯塔尔工业大学（TU Clausthal）

有了MSI Eureka后，我们在实验和计算机模拟初期通过使用高质量的严格评估数据，得以合理化研究计划 。MSI Eureka实实在在地使我们的任务更加简单,我们能更有效地达成研究目标，并将材料构成实例带入我们的教学工作中。

Prof. H.J. Seifert,
德国弗赖贝格工业大学（TU Bergakademie Freiberg）

客户举例

卡尔斯鲁厄理工学院，既是德国的一所大学同时也是国家级的大型研究中心，欧洲第四所理工大学

德国于利希研究中心，德国亥姆霍兹国家研究中心联合会的下属科研机构

伊斯坦布尔科技大学，位于土耳其，成立于1773年

德国克劳斯塔尔工业大学：建立于1775年，是德国著名的工业大学之一

Bhabha Atomic Research Center, BARC India

巴巴原子能研究中心，印度领先的多学科原子能研究中心，覆盖核科学和工程及相关领域

客户举例

俄罗斯科学院集团采购：约50家相关研究所

德国弗赖贝格工业大学

科威特政府石油公司

德国亚琛工业大学：德国最富盛名、最大的理工科学

洛斯诺普。格鲁门公司。世界第三大军工制造商，世界上最大的雷达和海军船只制造商

德国德累斯顿工业大学：德国最古老最有声誉的大学之一

提纲

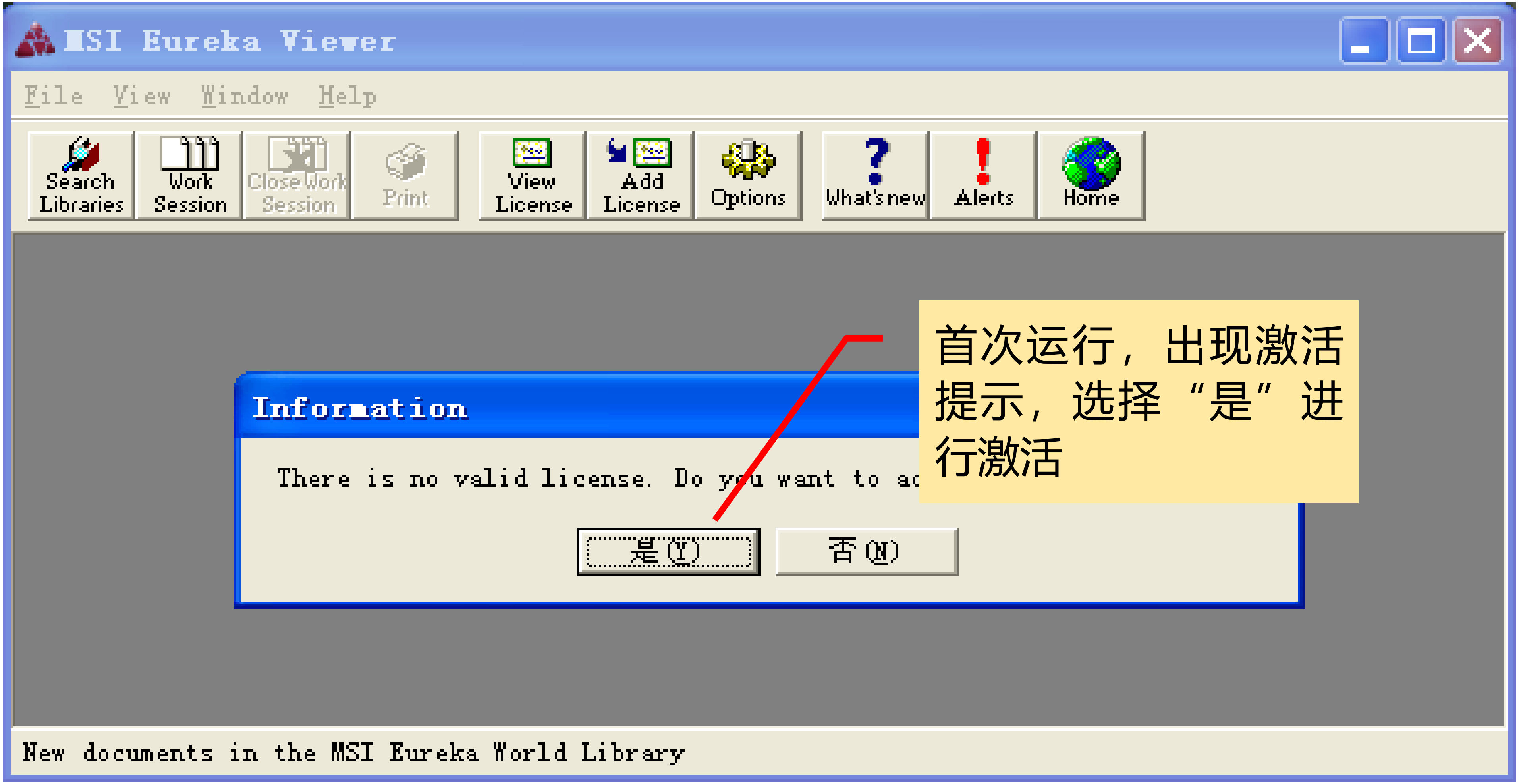
一、MSI公司及产品介绍

二、MSI数据库客户端使用介绍

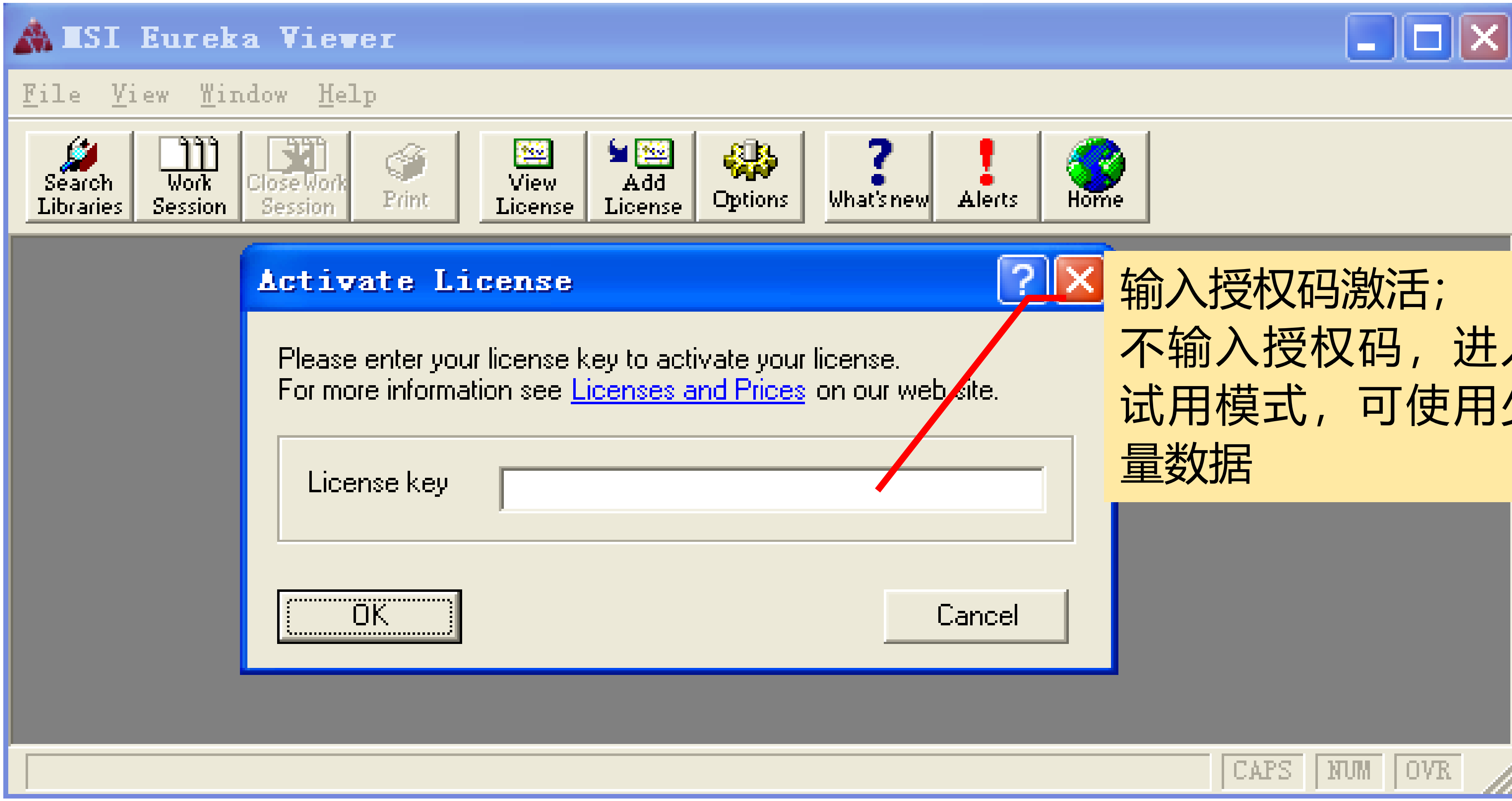
下载&安装

- 客户端: MSI Eureka Viewer(约7MB)
- 下载地址: http://www.msiport.com/discover-msi-eureka/how-to-access-msi-eureka/eureka-viewer/download-installation/
- 双击进行安装, 请从程序或桌面图标运行该软件

激活


MSI Eureka Viewer
File View Window Help
Search Libraries
Work Session
Close Work Session
Print
View License
Add License
Options
What's new
Alerts
Home
Information
There is no valid license. Do you want to ac
是(Y)
否(N)
New documents in the MSI Eureka World Library
首次运行，出现激活提示，选择“是”进行激活

激活

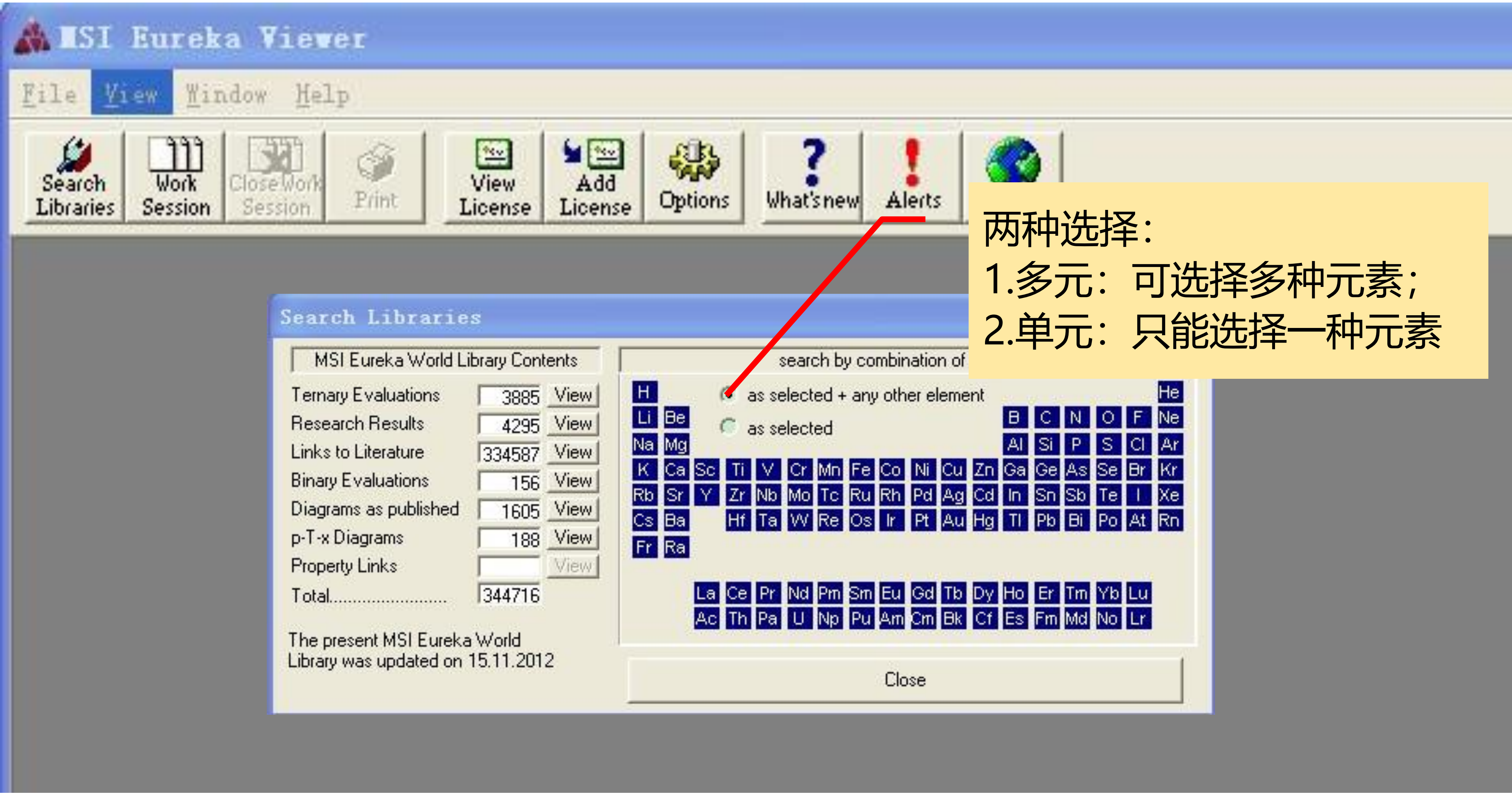


输入授权码激活；
不输入授权码，进入试用模式，可使用少量数据

界面简介


MSI Eureka Viewer
File View Window Help
主菜单
Search Libraries
Work Session
Close Work Session
Print
View License
Add License
Options
What's new
Alerts
Home
工具栏
现有
MSI网页链接
Work Session Contents
Ternary Evaluations
System Report Al-Cu-Mg
Text
System Report
Tables
Table 1: Solid Phases
Table 2: Invariant Equilibria
Table 3: Reported data for the invariant reaction E2
Table 4: Reported data for the invariant reaction E4
Table 5: Reported data for the invariant reaction U
Table 6: Reported data for the invariant reaction E6
Table 7: Lattice parameters of (Al) phase [51Poo]
References
Literature
Reaction Schemes
Fig. 6: The reaction scheme, part 1
Fig. 6a: The reaction scheme, part 2
Diagrams
Fig. 2: Liquidus projection with the invariant liquid c
Fig. 3: Isothermal section at 400 from 33.3 to 100
Fig. 4: Isothermal section at 400 [52Ura]
Fig. 5: Liquidus projection with liquidus isotherms,
Fig. 7: Isothermal sections in the Al-rich corner at 4
Fig. 8: Isothermal sections in Al-rich corner at temp
Fig. 9: Solubility of Al and Mg in Cu [57Rog]
Schematic
Fig. 1: Phases detected along the 33.3 at.% Mg se
Research Results
Links to Literature
Binary Evaluations
Diagrams as published
p-T-x Diagrams
Property Links
Books
License information
License Information
Named Account ID: 138-098-084-089-000-061
Public Access Point ID: 081-225-233-235-008-068
Valid Licenses
Total number: 1
?Evaluation License D
Licensee MSI Eureka Evaluation
Contract/Schedule D/8
Validity 01.01.2012 to 01.01.2013
Documents Categories Element Systems
1 Ag,Cu,Sn
1 As,Ga,Pt
1 Al,Cu,Mg
1 Al,Mg,Si
1 Fe,Ni,Ti
2 Al,Cu
2 Cu,Ti
3 Au,Sn
3 C,Ti
3 Co,Cr,Fe
3 Cr,Mo,Ni
4 H,Ti
4 Cu,S
5 Au,Te
5 Bi,Pd

使用举例 —— 体系选择: Cu-Al-Mg

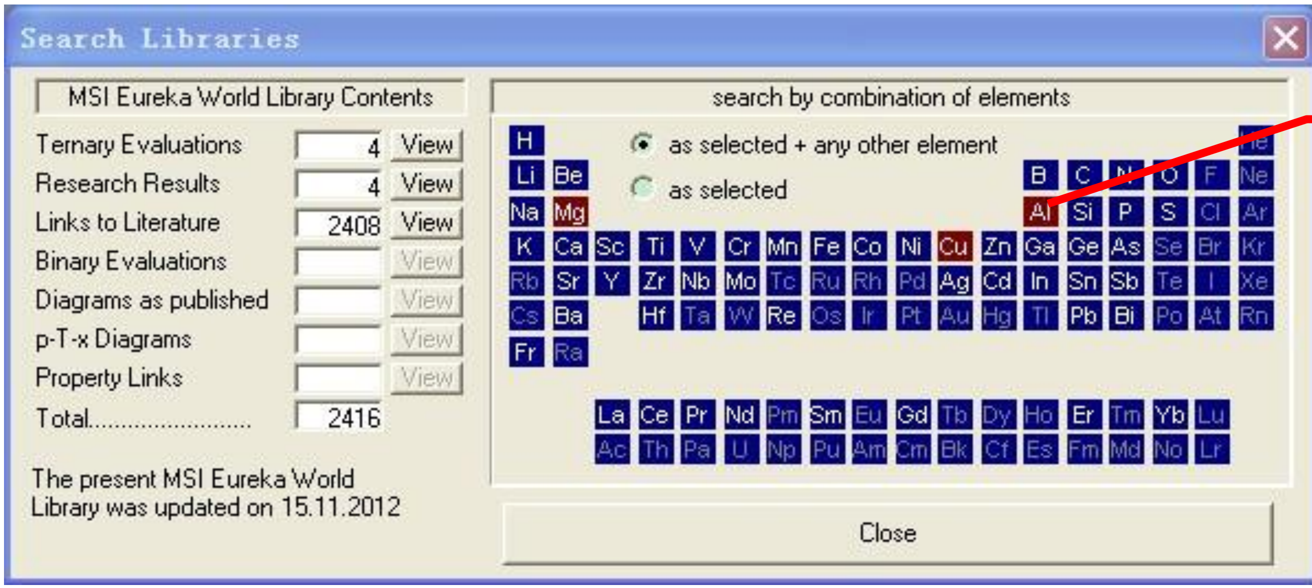


两种选择：

1.多元：可选择多种元素；

2.单元：只能选择一种元素

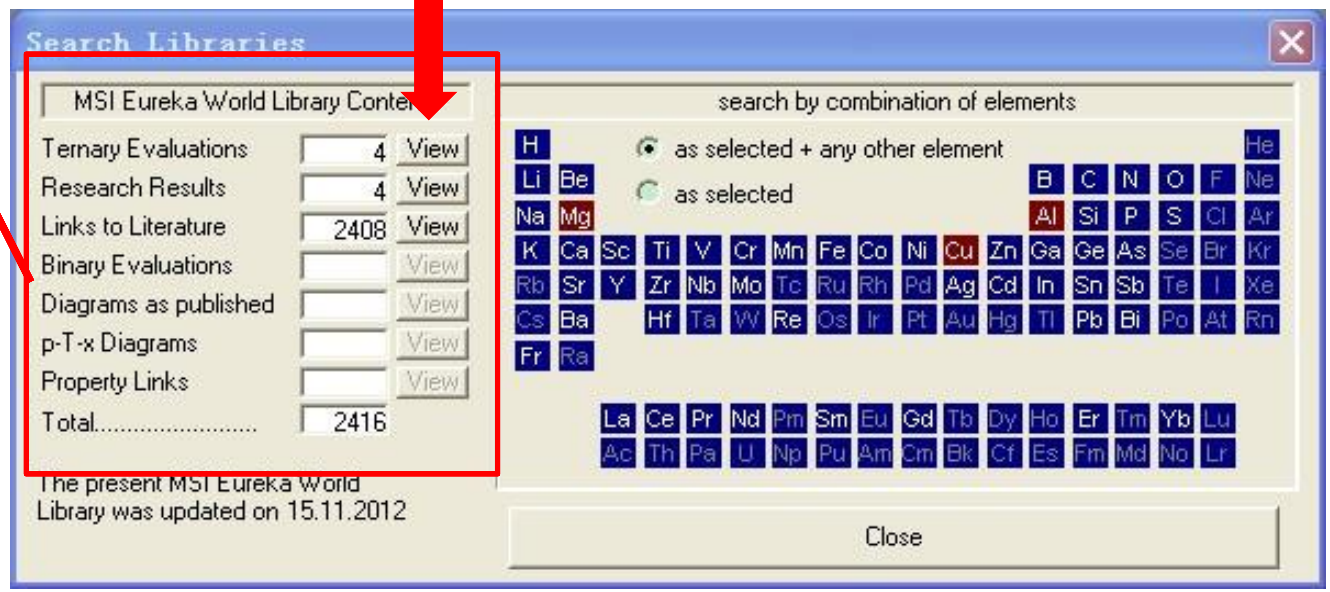
使用举例 —— 体系选择: Cu-Al-Mg



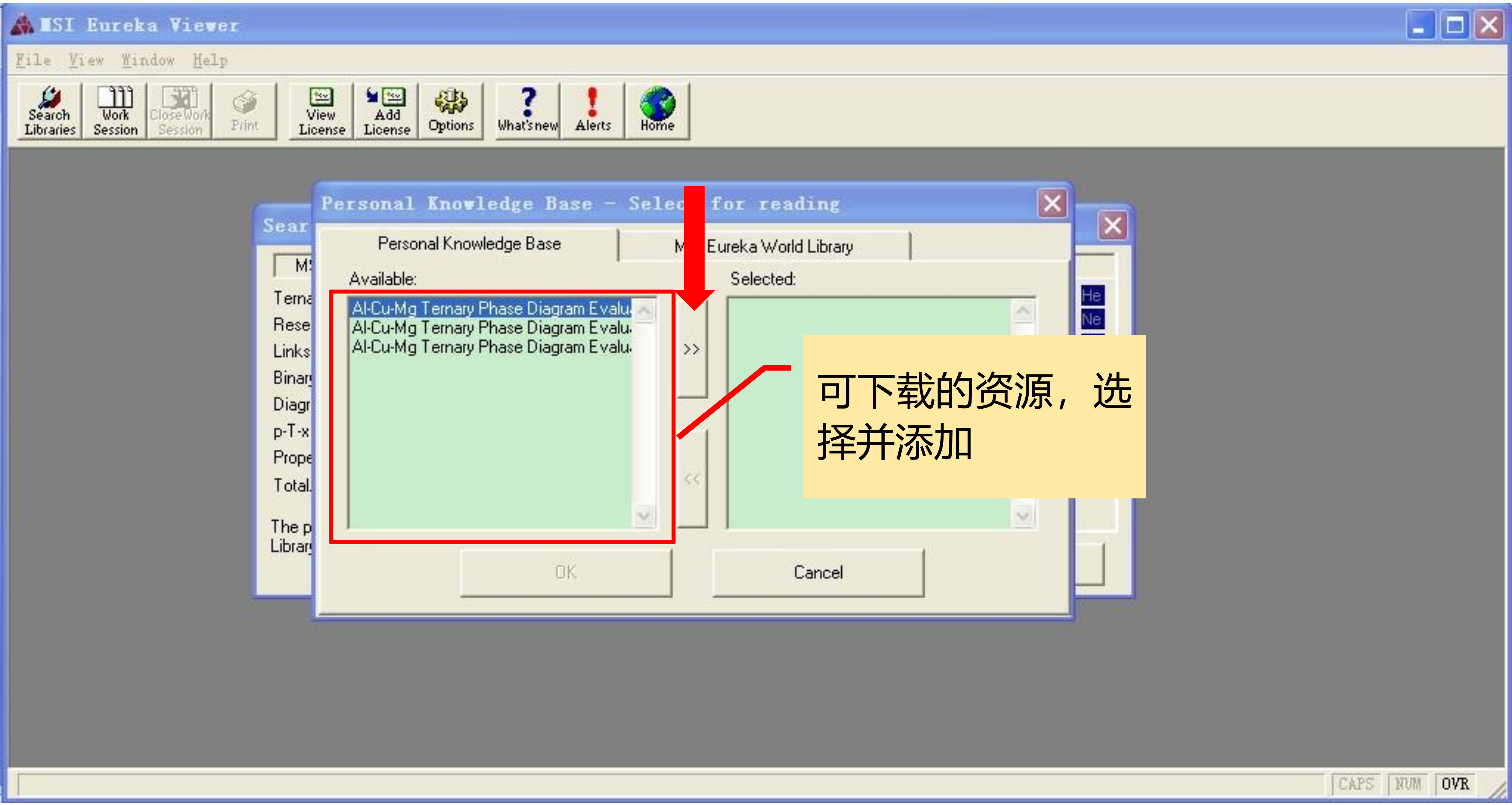
☆ 提示：选定的元素背景变棕色，不能选择的元素背景变灰

使用举例 —— 体系选择: Cu-Al-Mg

数据库所含的内容信息，点击“View”可查看



使用举例 —— 数据下载


MSI Eureka Viewer
File View Window Help
Search Libraries
Work Session
Close Work Session
Print
View License
Add License
Options
What's new
Alerts
Home
Personal Knowledge Base - Select for reading
Personal Knowledge Base
MSI Eureka World Library
Available:
Selected:
Al-Cu-Mg Ternary Phase Diagram Evalu
Al-Cu-Mg Ternary Phase Diagram Evalu
Al-Cu-Mg Ternary Phase Diagram Evalu
OK
Cancel
可下载的资源，选择并添加
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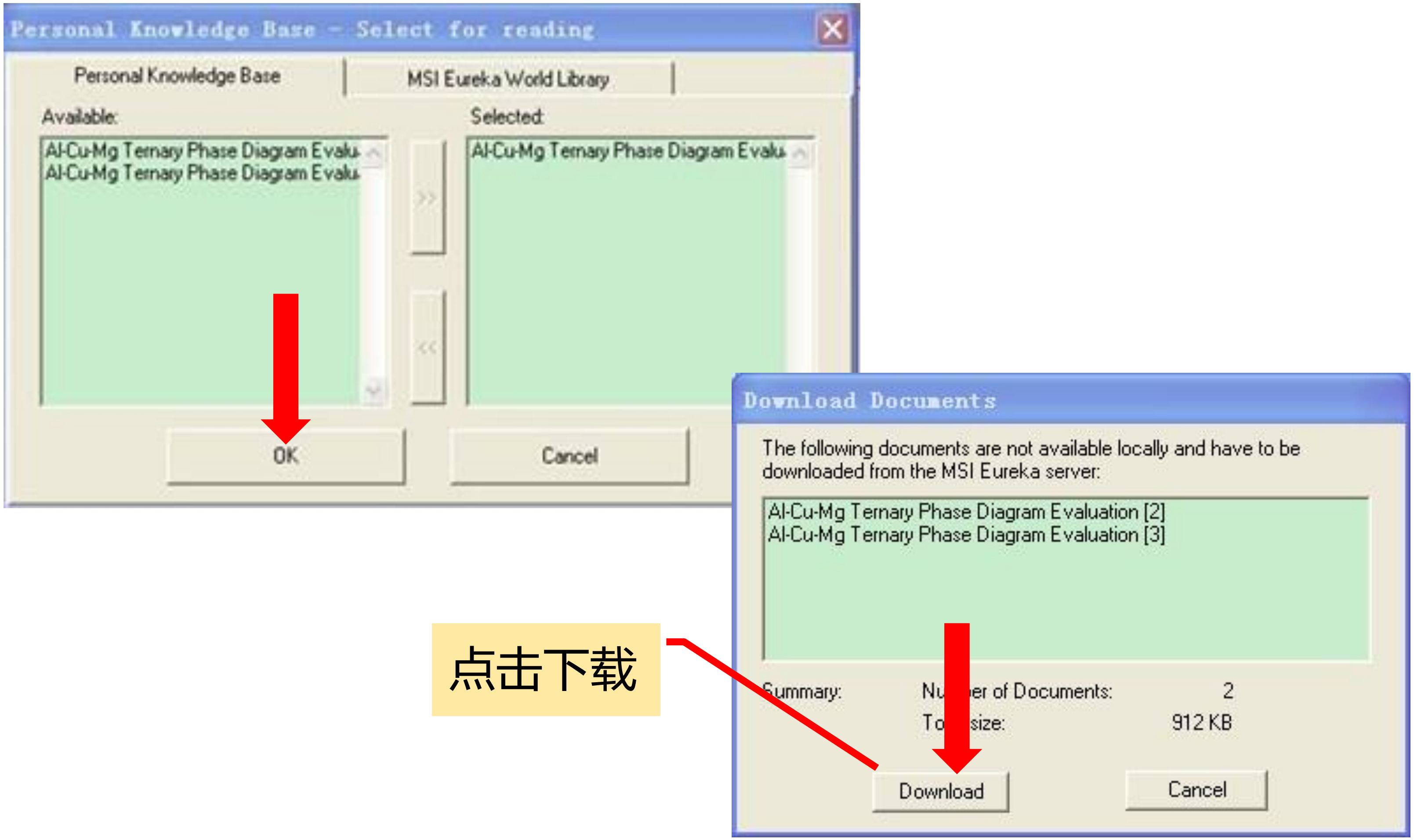

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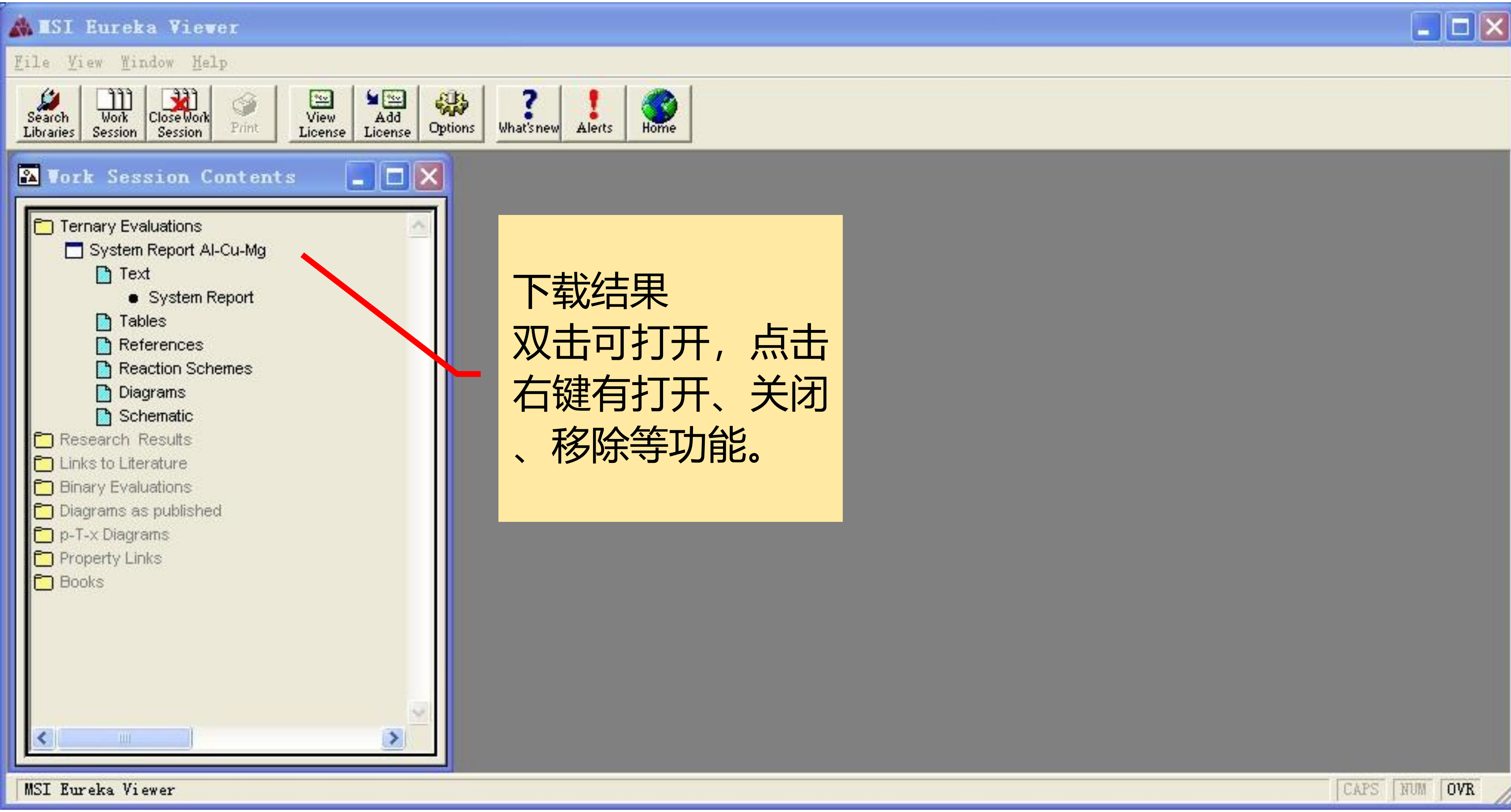

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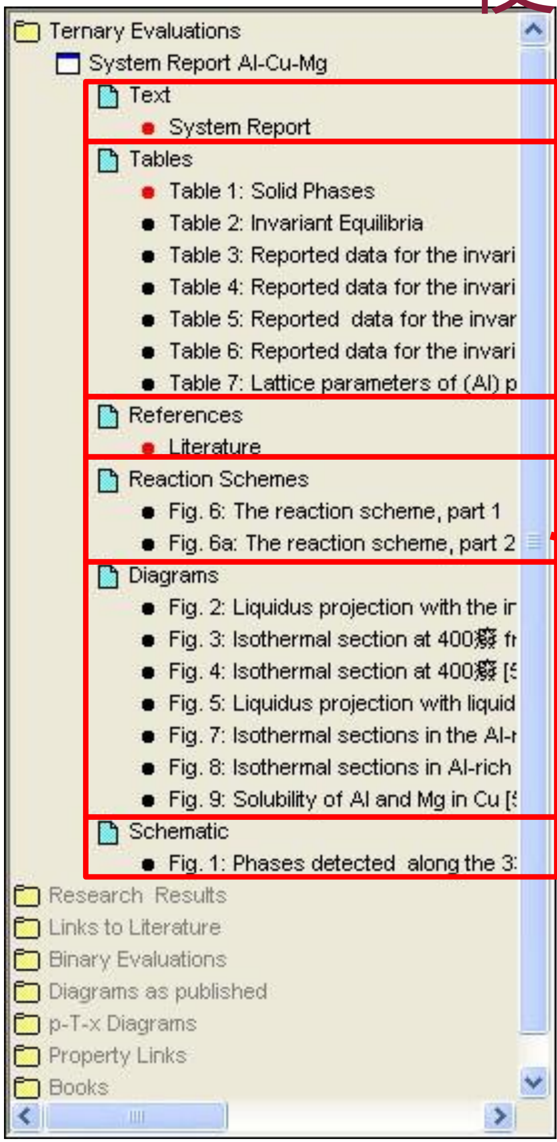

关于Cu-Al-Mg三元相图的介绍文档，包括二元边界系统，三元固相、液相面，等温截面，零变点等信息

表格信息，包含Cu-Al-Mg三元系中固相、反应、零变点等的温度、成分及其它信息

参考文献

相变过程中的反应流程图

三元截面相图

伪二元系相变过程

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Aluminium - Copper - Magnesium

G膦ter Effenberg and Alan Prince

Introduction

The equilibria in the Al-Cu-Mg system are complex and not fully understood. The complexity arises from the occurrence of six ternary phases, and the lack of understanding from a need to clarify experimentally the ternary equilibria involving three Laves phases, λ_{1-3}. Four ternary compounds have been studied extensively. The S phase is based on the Al_2CuMg composition, V on $Al_{11}Cu_{11}Mg_4$ and Q on $Al_7Cu_3Mg_6$. Each phase exists over a very limited homogeneity range. The T phase has a broad range of homogeneity and the formula $(Al_xCu_{1-x})_{49}Mg_{32}$ adequately describes the composition. Three Laves phases have been identified. The λ_1 phase with a Cu_2Mg type structure is a solution phase of the binary Cu_2Mg compound with replacement of the Cu atoms by Al along the 33.3 at.% Mg section. At a composition close to the $Al_2Cu_4Mg_3$ formula, the λ_1 phase melts congruently at ≈940°C. Further replacement of Cu by Al stabilizes the λ_2 phase with a $MgNi_2$ type structure and then the λ_3 phase with a $MgZn_2$ type structure. A variety of polytype structures with different atom layer stacking sequences have been observed between the $MgNi_2$ and $MgZn_2$ type phases. The λ_{2-3} phases appear to be formed by peritectic reaction and each Laves phase is associated with a region in which it forms as the primary phase on solidification of melts. A 400°C isothermal section, Fig. 3, indicates the equilibrium relationships involving phases λ_1, λ_2 and λ_3 for alloys containing 33.3 at.% Mg or more [81Mel2]. No comparable information is available for alloys with less than 33.3 at.% Mg. The liquidus projection, presented by [52Ura], does not include the monovariant curves associated with the $L + \lambda_1 \rightleftharpoons \lambda_2$ and $L + \lambda_2 \rightleftharpoons \lambda_3$ peritectic reactions (Fig. 5). They have been tentatively inserted in the projection of Fig. 2. The Laves phases are the predominant primary phases, but also the regions for primary solidification of (Al) and (Mg) are relatively large. Six pseudobinary reactions have been identified, Table 2, and the pseudobinary reaction e_2 suggested. The invariant reactions associated with the primary (Al)

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region at 400°C to include the AlCuMg ... ve in Fig. 4 and does not
appear to be justified on the basis of r... of [81Mel2]. The Laves
phase associated with the pseudobina... with a greater probability
of being λ_3. [38Pet1] regarded the Cu... proved this assumption.

Invariant Equilibria

Table 2 lists the invariant reactions proposed for the Al-Cu-Mg ternary system and may be read in conjunction with Fig. 2.
The reaction scheme, Fig. 6 and Fig. 6a, is simplified, as β_0 and β, γ_0 and γ_1, ε_1 and ε_2 and the different Laves
phases are not distinguished and denoted by β, γ, ε and λ, respectively. The solid state reactions of the Cu-rich Al-Cu
phases and of the Al-Mg phases are neglected. The three phase equilibria with solid phases not stable at room
temperature are underlined by dashed lines. The ternary eutectic reaction E_2 has been widely studied, Table 3. The flat
nature of the liquidus surface near to E_4 has led to a considerable scatter in quoted compositions and temperatures,
Table 4. The reaction has normally been quoted as a ternary eutectic reaction and this is accepted. The transition
reaction U_{10} has also been widely studied, Table 5. The work of [46Ura, 49Ura2] and [48Bro] rests on an examination of
a greater number of alloys than other work and allowed a more pre... at U_{10}.
Ternary eutectic reactions in Mg-rich alloys occur at E_3 and E_6. Th... 3Bas,
34Por] or 2 K [49Ura2] below the binary Cu-Mg eutectic temperatu... r the
liquid composition at E_3 since they indicate an addition of 0.5% Al... 1 K
compared with 2% Al found by [49Ura2] for a 2 K depression. The... arded as
involving a Laves phase, but the work of [51Mir2] indicates that thi... ot detected
by the previous workers. The liquid composition quoted by [33Bas... d this
composition to be in a primary Laves phase field.
The reactions at E_5, U_9, U_{13}, U_{14} and P_2 are from Soviet studies. The ternary eutectic reaction at E_5 is due to
[49Ura2]. The Al-Mg binary system [81Sch] indicates the peritectic formation of two binary phases designated X and Y.
The ternary transition reactions U_{11} and U_{12} are introduced as speculative; no experimental data exists to substantiate
either reaction. The reaction at P_2 was initially regarded as a transition reaction [37Nis, 52Han], whereas [46Ura] and
[49Ura2] considered it to be a ternary peritectic reaction, $L + \lambda_1 + S \rightleftharpoons T$. [51Mir2] gives it as $L + \lambda_1 + S \rightleftharpoons Q$. There is doubt

[46Ura]
G.G. URAZOV and D.A. PETROV, "Investigation of the Al-Cu-Mg Phase Diagram" (in Russian), Zhur. Fiz. Khim., 20, 387-398 (1946)
(Equi. Diagram, Experimental, 10)

Table 2: Invariant Equilibria

三元系中零变点处的所有反应信息

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Inv iant Equilibria

Table 2 lists the invariant ... nction with Fig. 2.
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Table 2: Invariant Equilibria

T (°C) Reaction	Type	Phase	Composition (at. %) Al	Cu	Mg
665 $L + \varepsilon_2 + \lambda_{1\text{-}3} \rightleftharpoons V$	P_1	L	45.9	42.0	12.1
520 $L + \lambda_{1\text{-}3} + S \rightleftharpoons Q$	P_2	L	53.6	6.7	39.7
964-1022 $l + \beta_0 \rightleftharpoons \beta + \gamma_0$	U_1				
818 $L + \gamma_0 \rightleftharpoons \lambda_1 + \beta$	U_2	L	25.5	58.7	15.8
775 $L + \gamma_0 \rightleftharpoons \varepsilon_1 + \lambda$	U_3	L	34.3	50.8	14.9
724 $L + \varepsilon_1 \rightleftharpoons \varepsilon_2 + \lambda_{1\text{-}3}$	U_4	L	39.5	46.2	14.3
595	U_5	L	53.5	38.1	8.4

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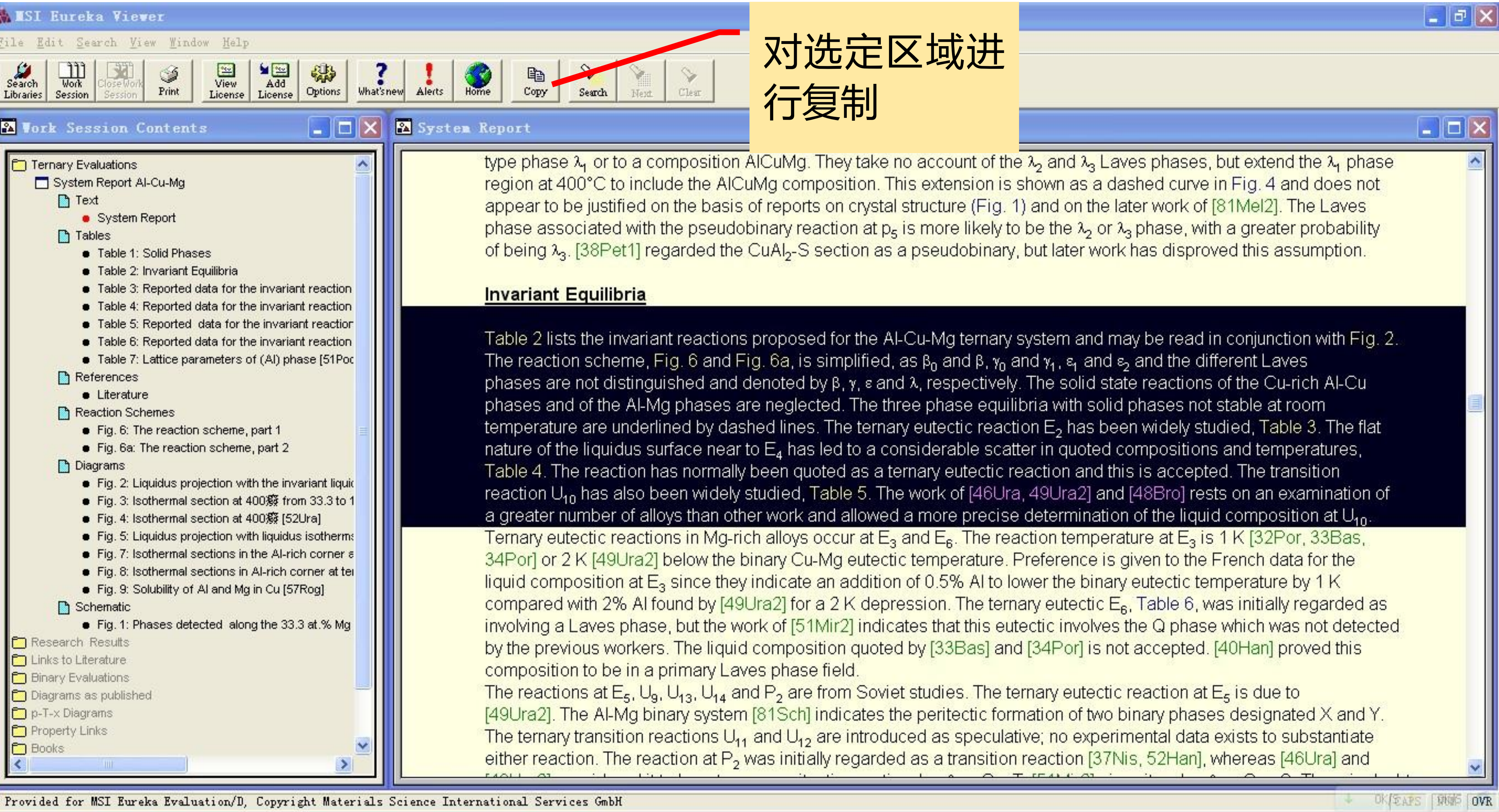

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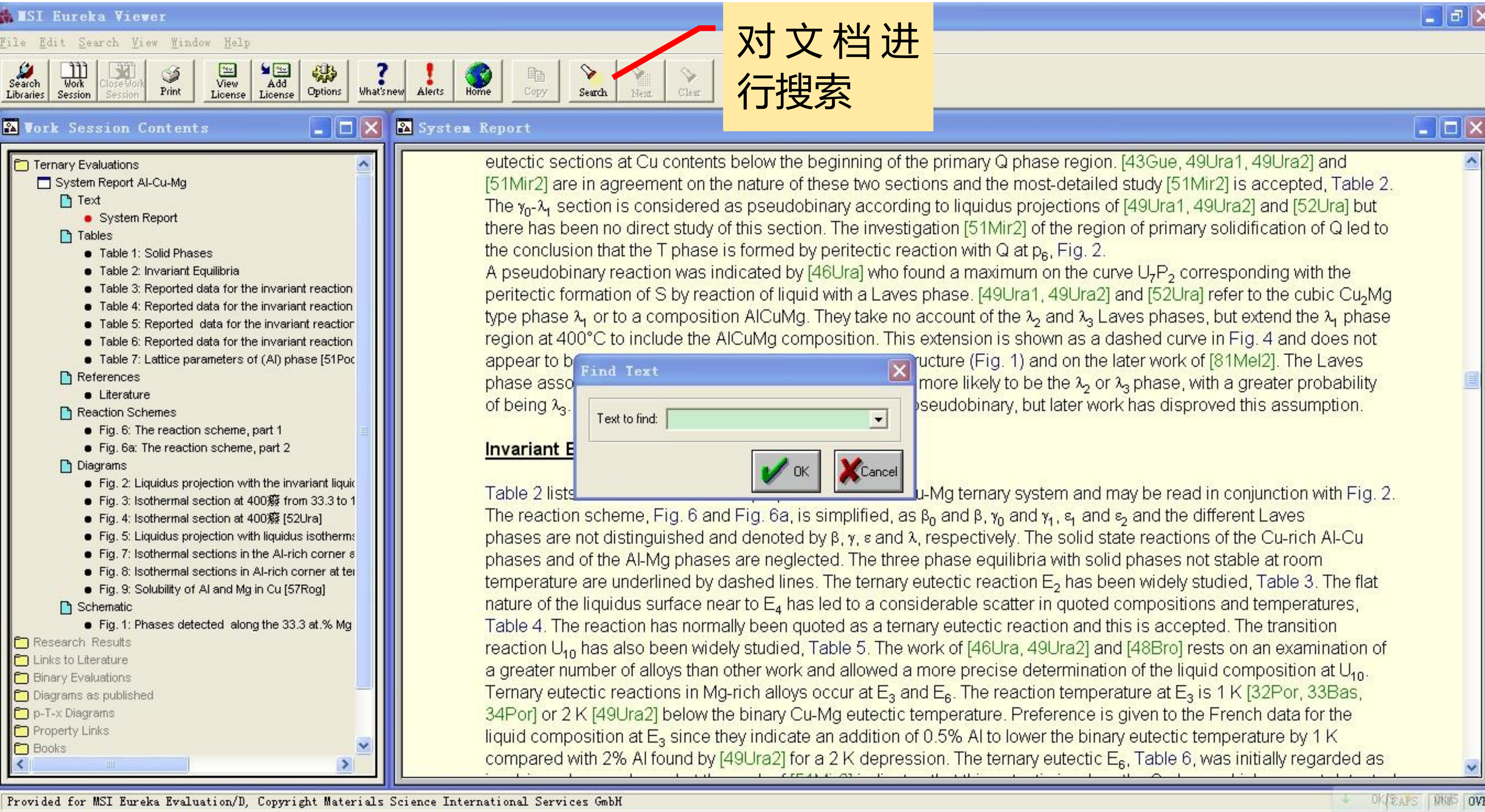
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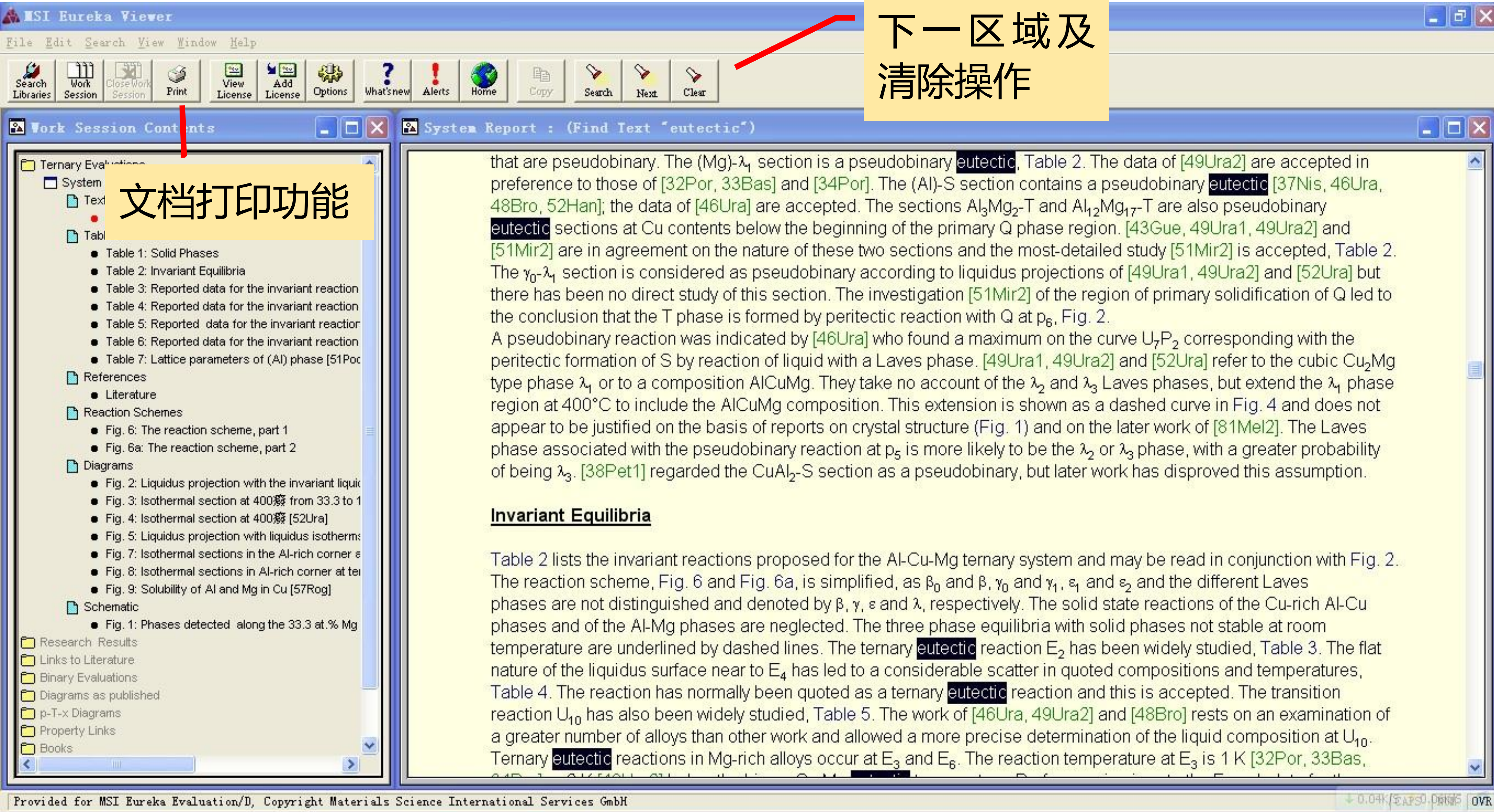

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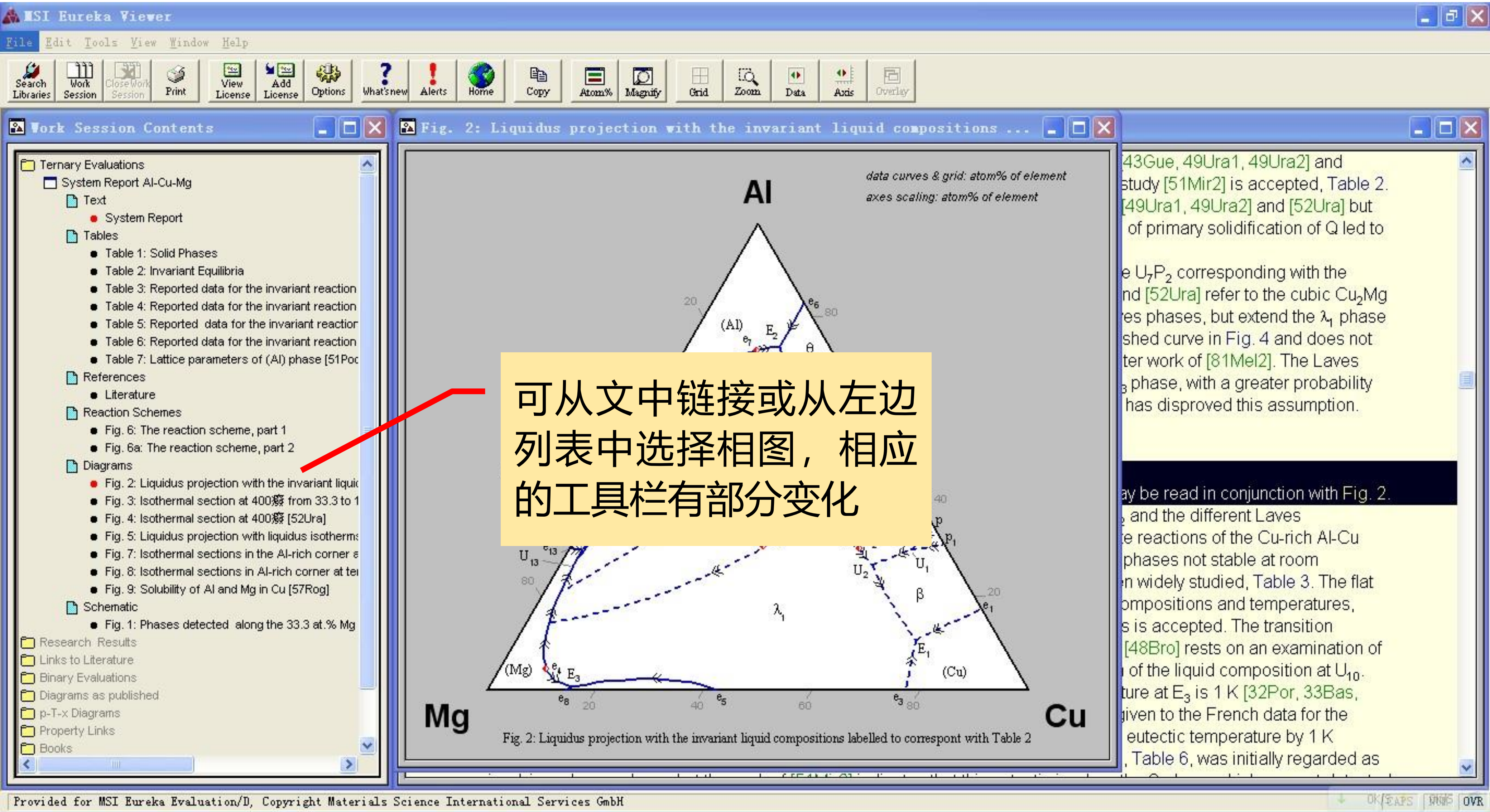

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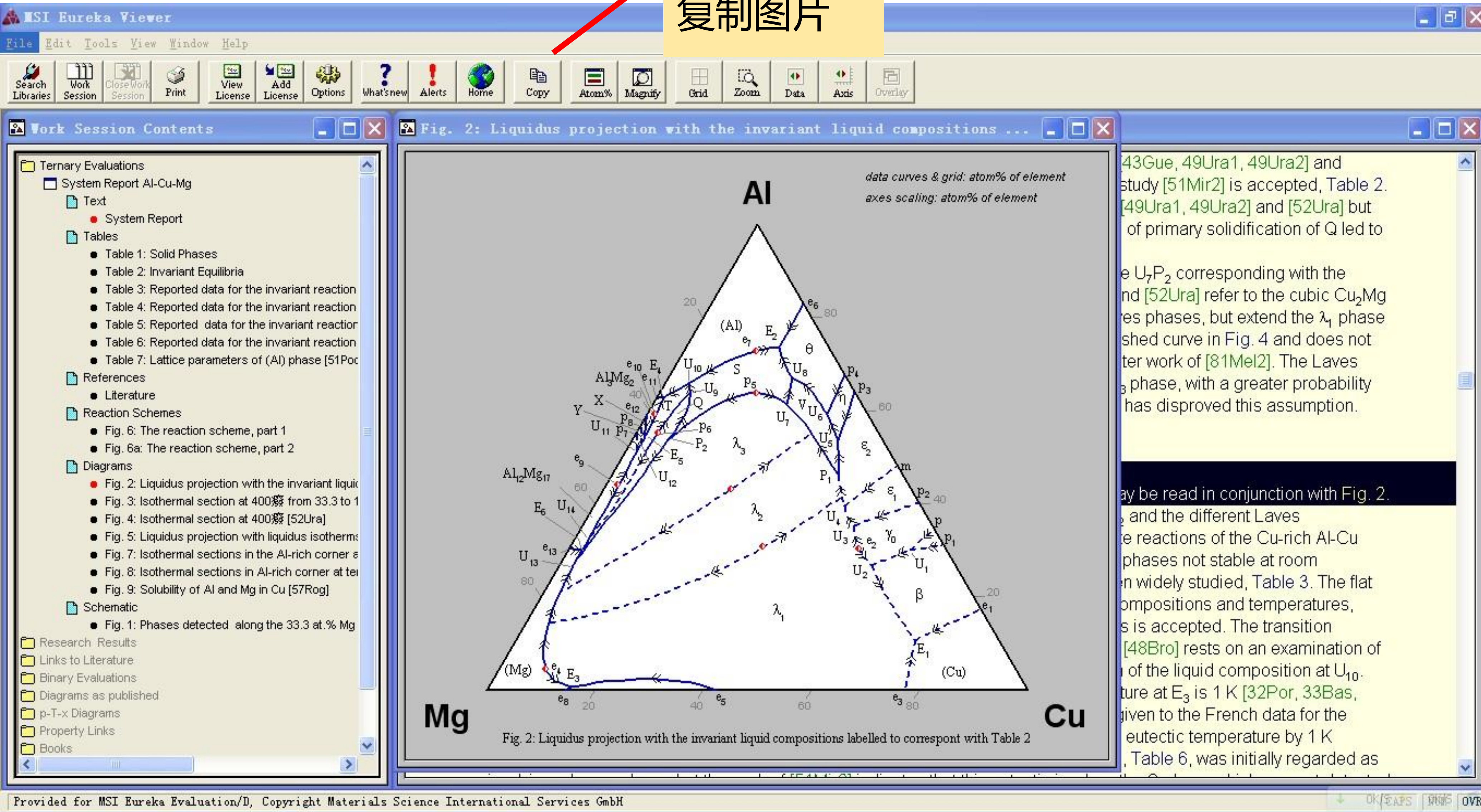
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data curves & grid: atom% of element
axes scaling: atom% of element
Al
Mg
Cu
Fig. 2: Liquidus projection with the invariant liquid compositions labelled to correspont with Table 2
43Gue, 49Ura1, 49Ura2] and
study [51Mir2] is accepted, Table 2.
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ture at E3 is 1 K [32Por, 33Bas,
given to the French data for the
eutectic temperature by 1 K
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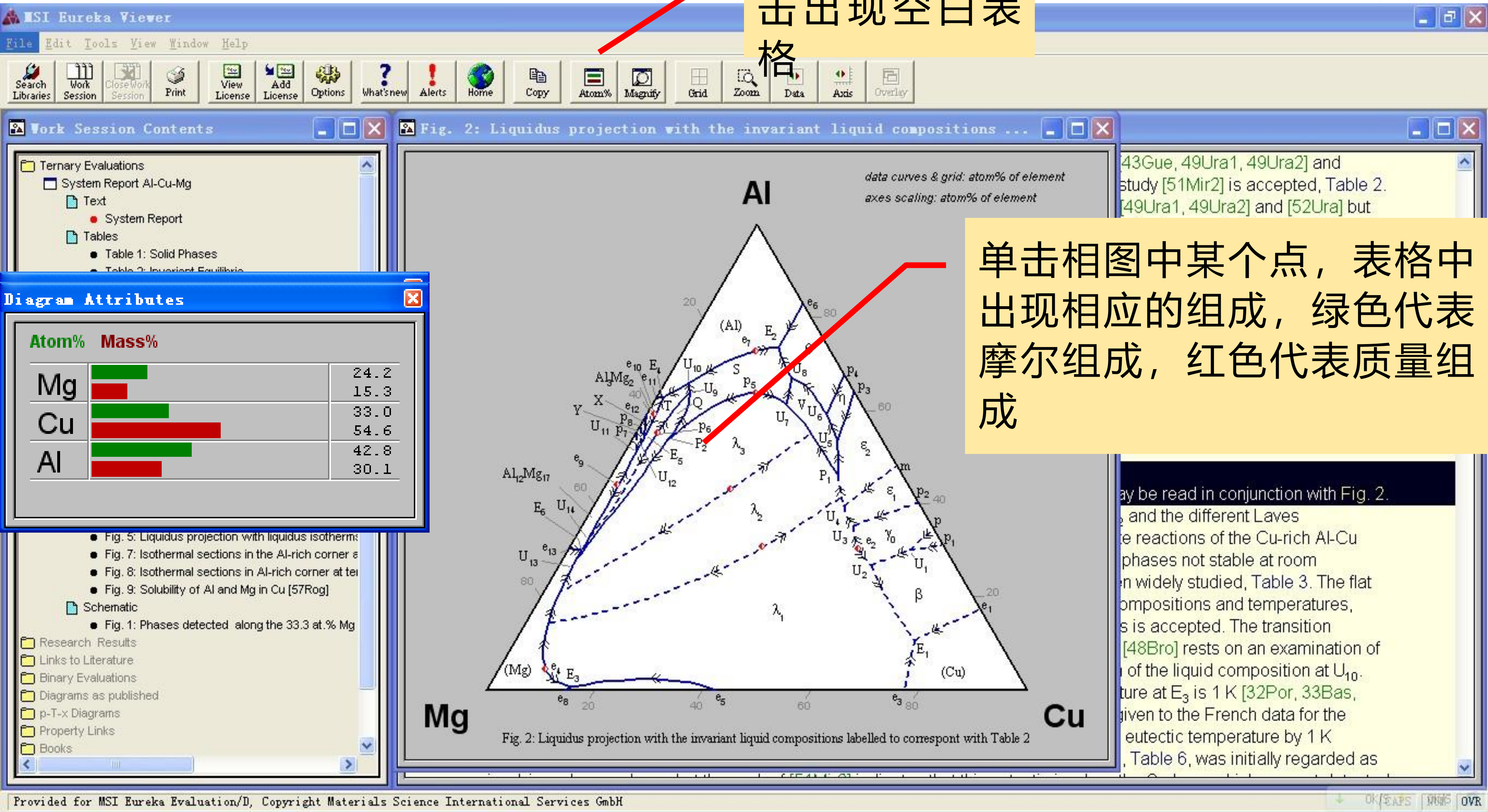
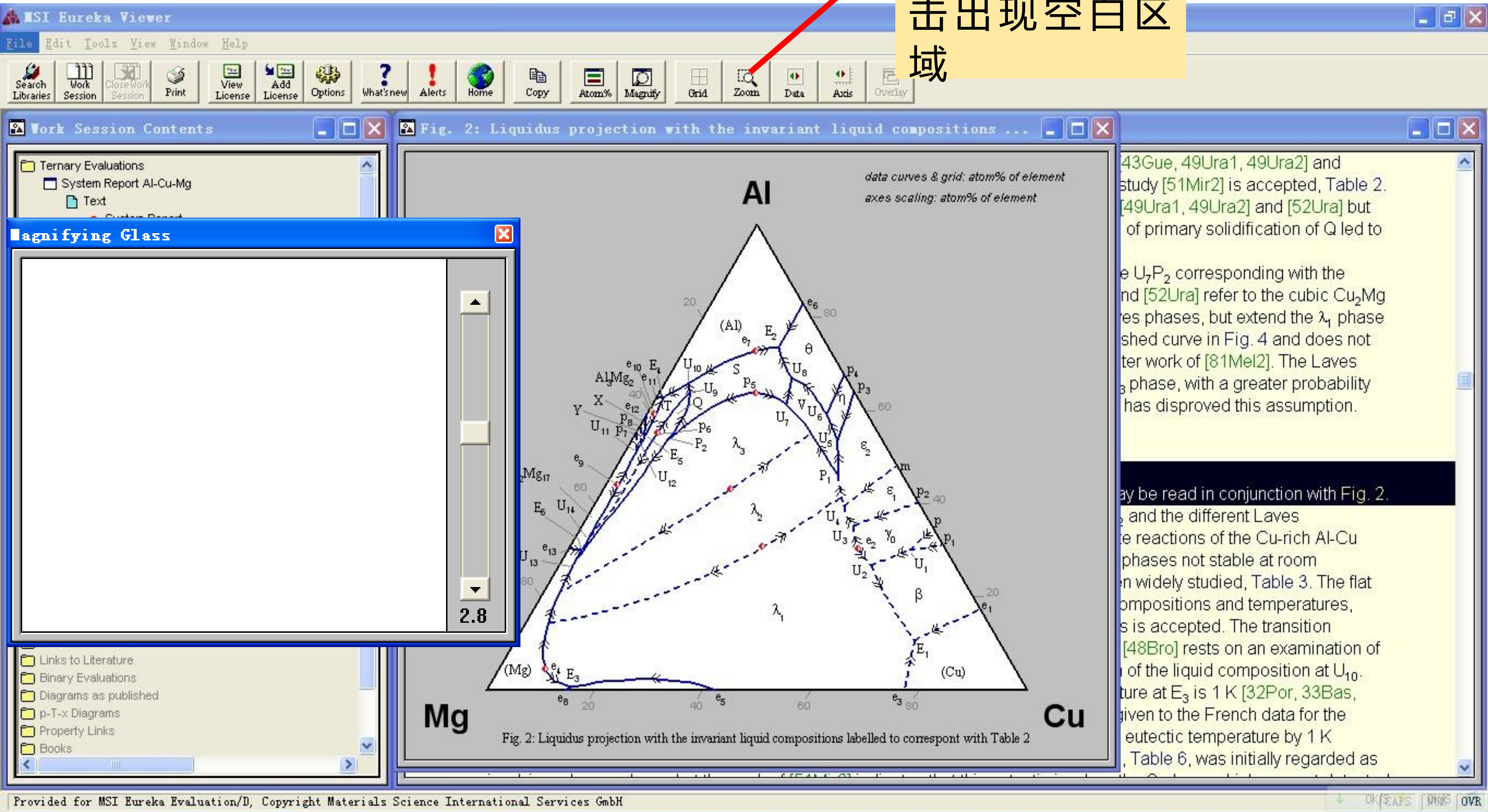
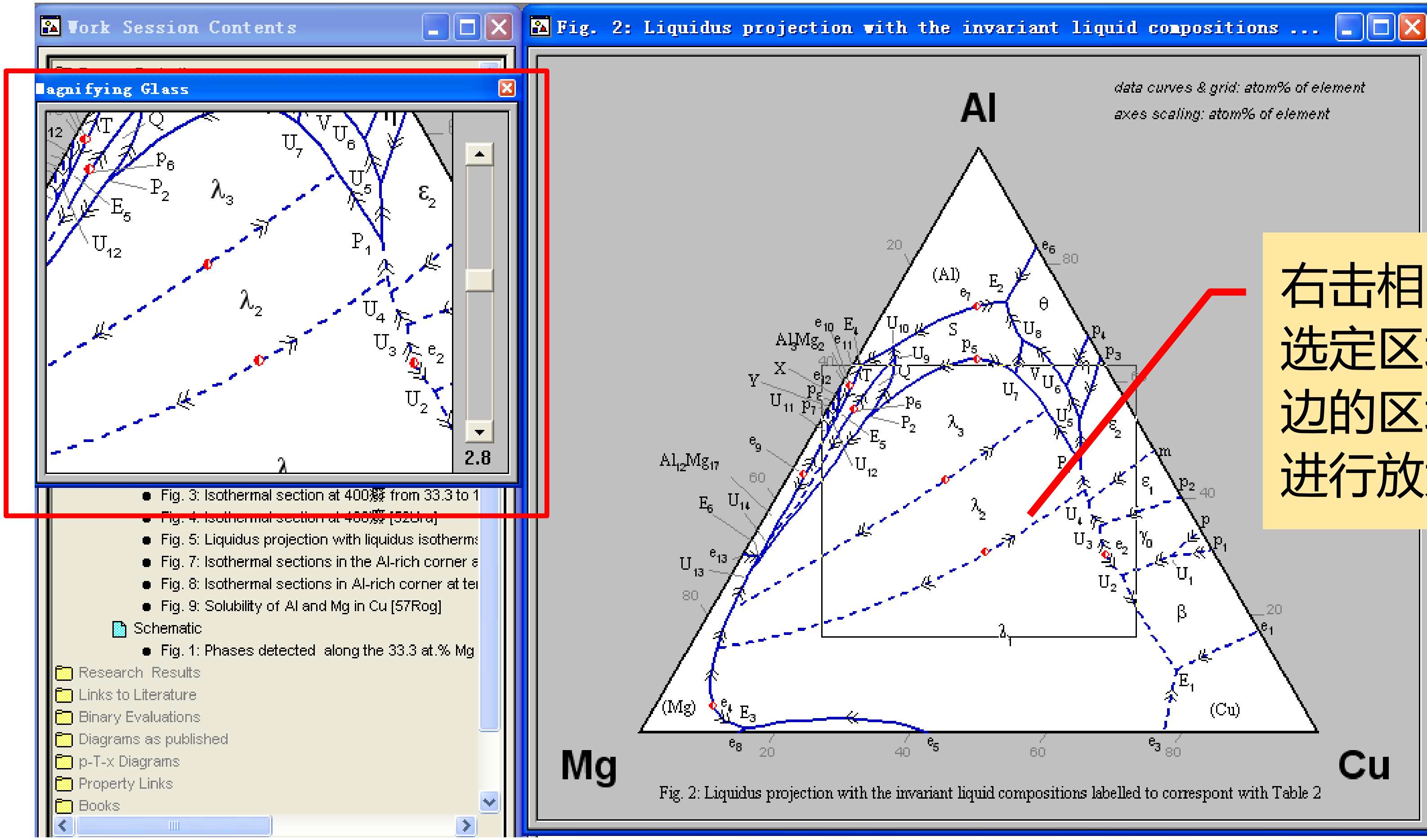
物质成分，单击出现空白表格

单击相图中某个点，表格中出现相应的组成，绿色代表摩尔组成，红色代表质量组成



放大功能，单击出现空白区域





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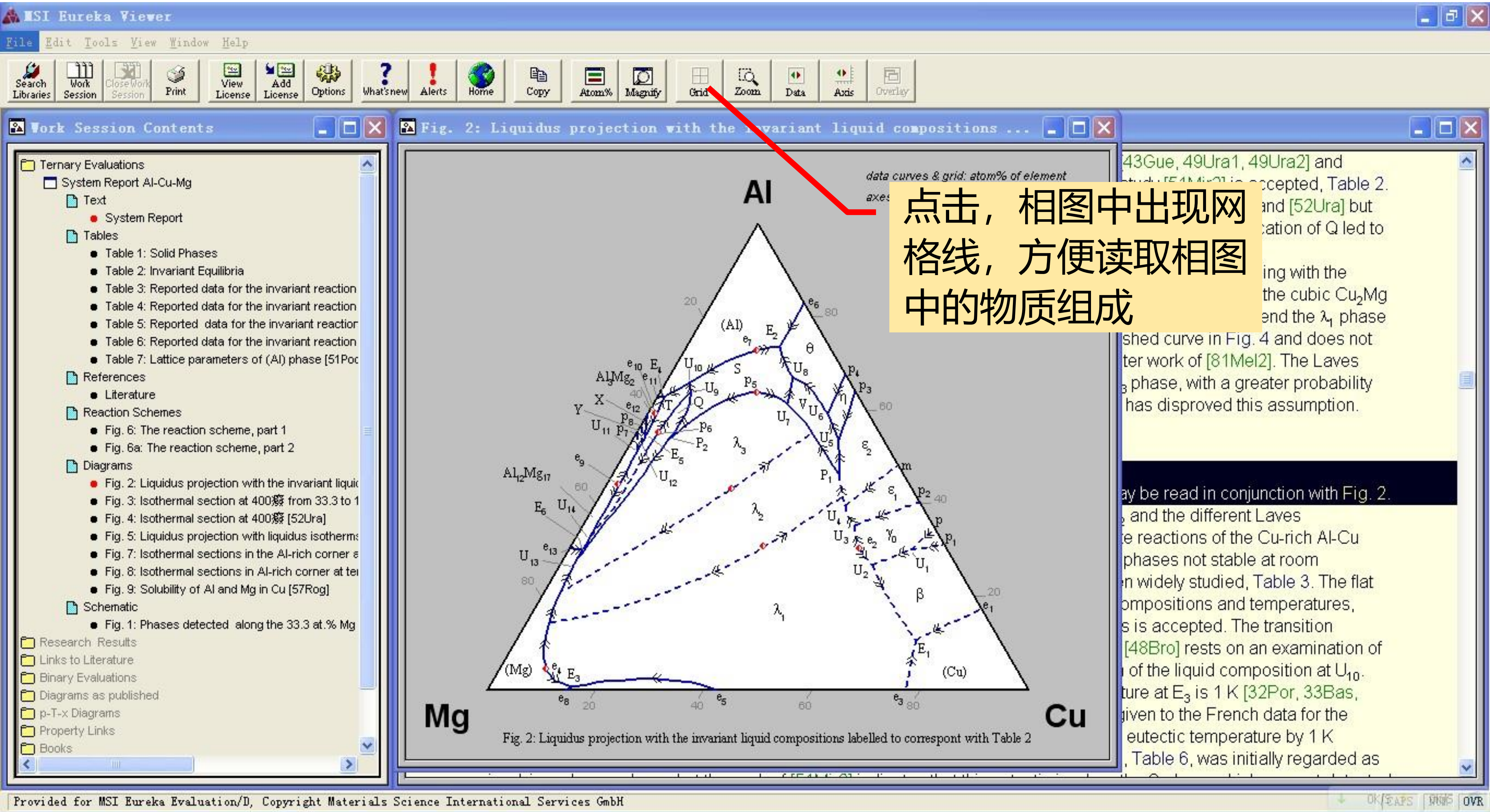
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Fig. 2: Liquidus projection with the invariant liquid compositions ...
点击，相图中出现网格线，方便读取相图中的物质组成
Al
Mg
Cu
Fig. 2: Liquidus projection with the invariant liquid compositions labelled to correspont with Table 2
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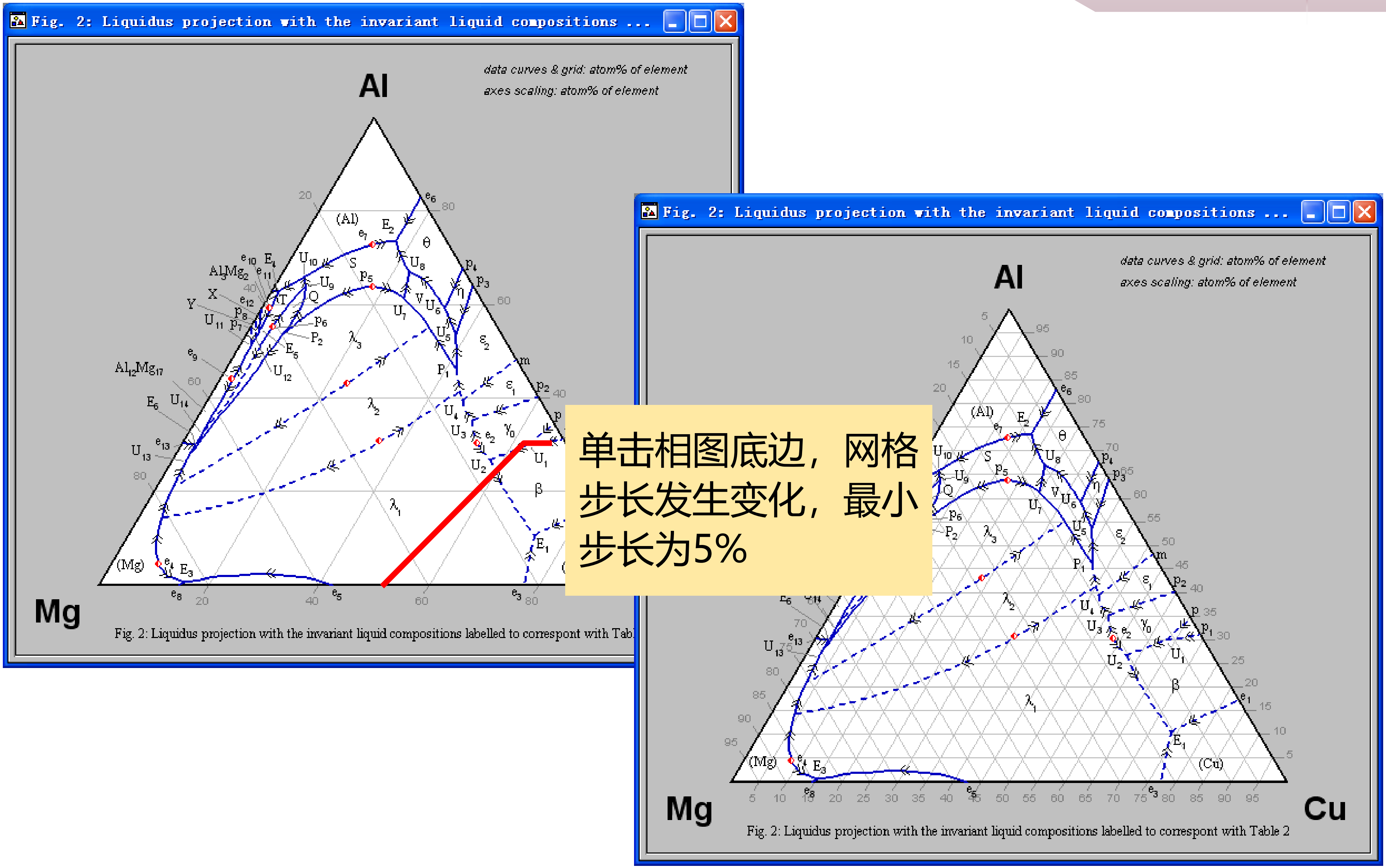
Fig. 2: Liquidus projection with the invariant liquid compositions ...
data curves & grid: atom% of element
axes scaling: atom% of element
Al
Mg
Cu
Fig. 2: Liquidus projection with the invariant liquid compositions labelled to correspont with Table 2
单击相图底边，网格步长发生变化，最小步长为5%

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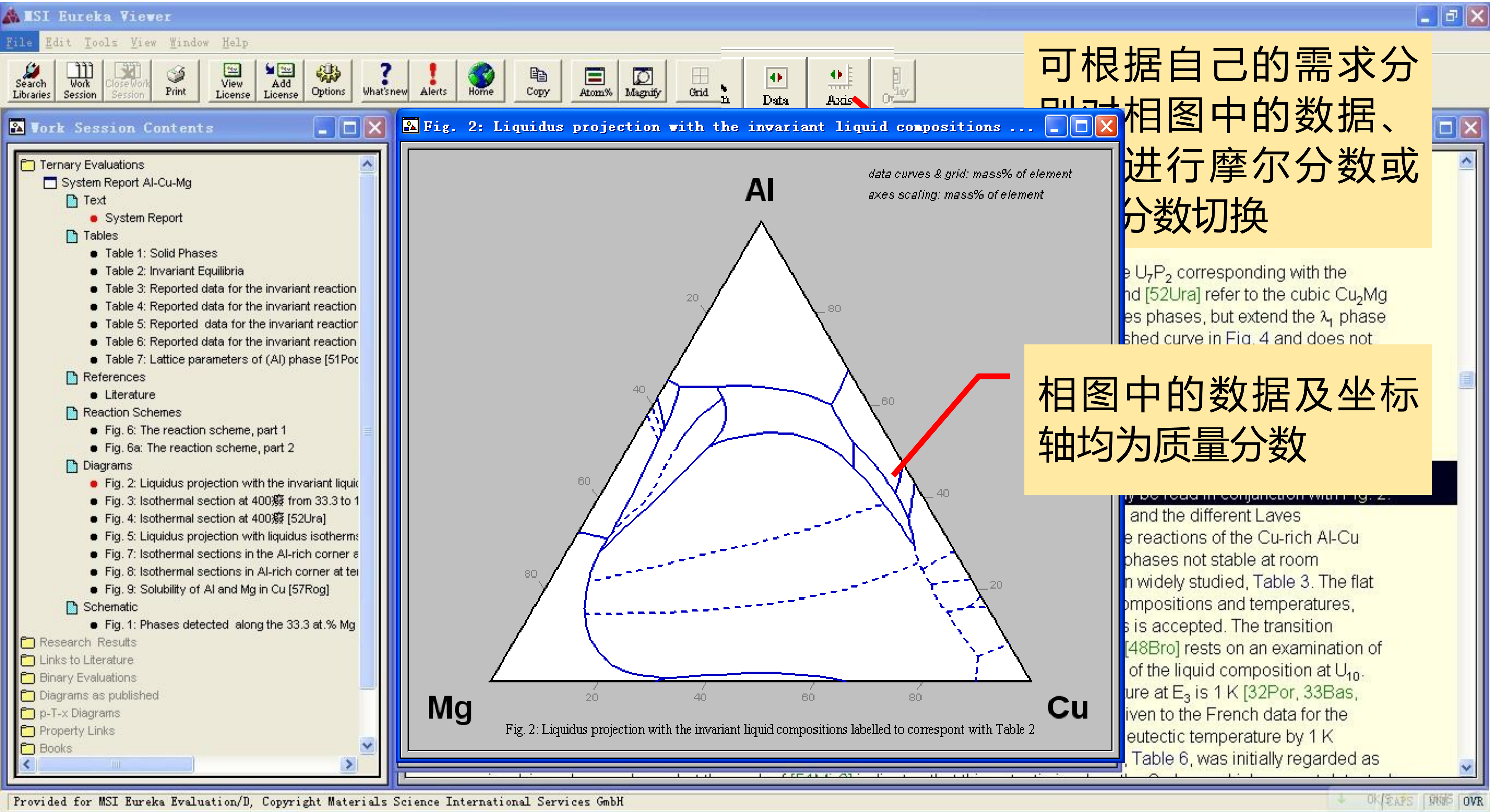

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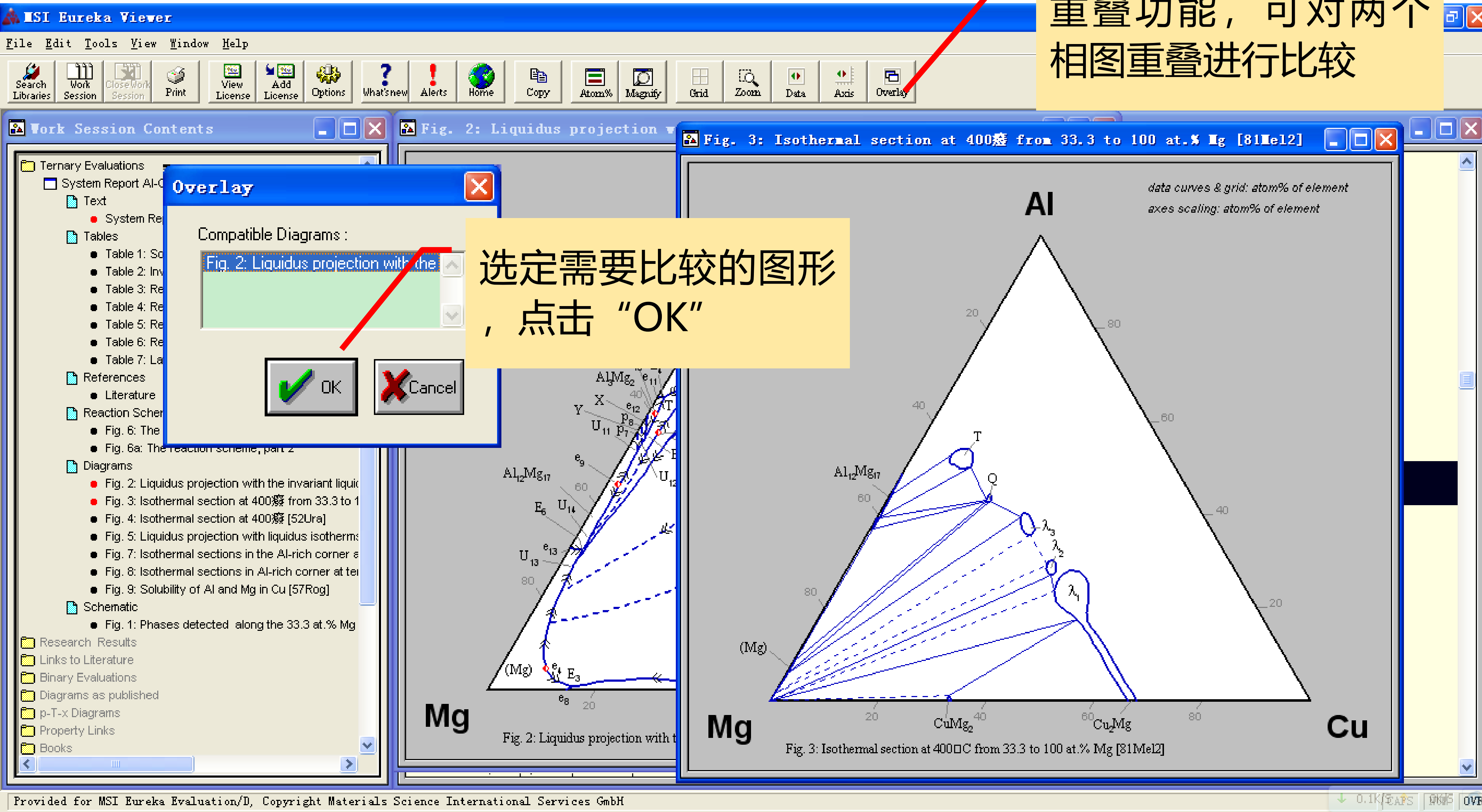
相图中的数据及坐标轴均为质量分数



重叠功能，可对两个相图重叠进行比较

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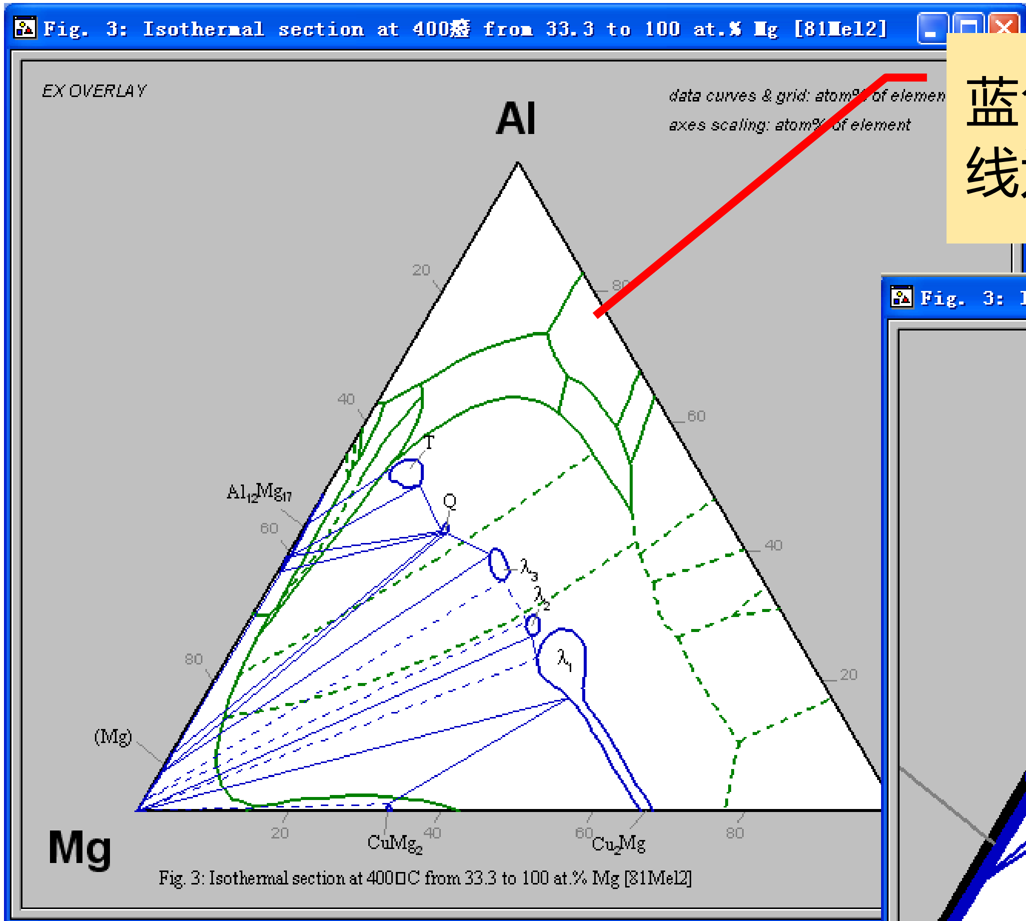
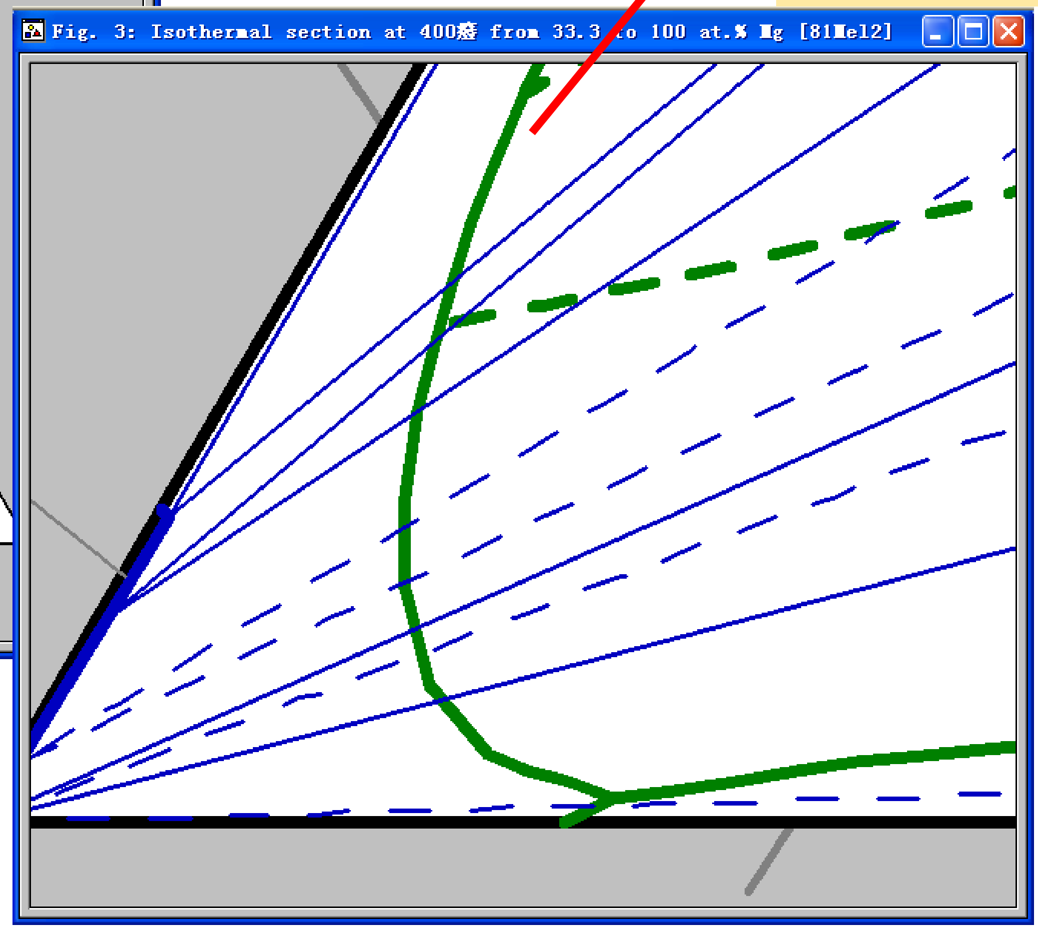


蓝色线为原图，绿色线为叠加上去的相图

放大相图的部分区域



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