Research on magnesia sintering system based on flotation magnesite

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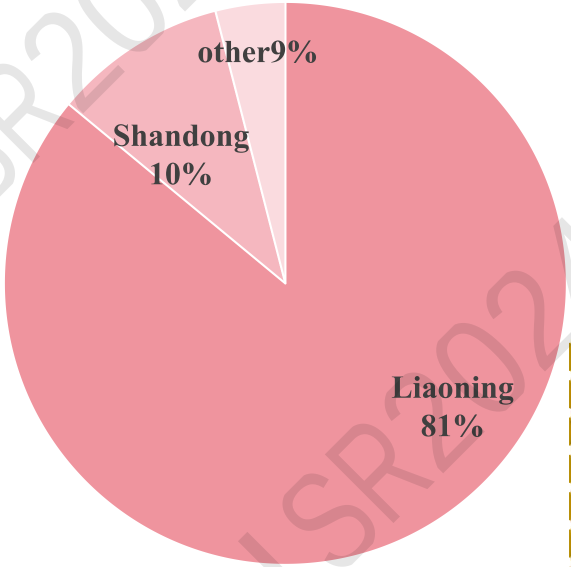
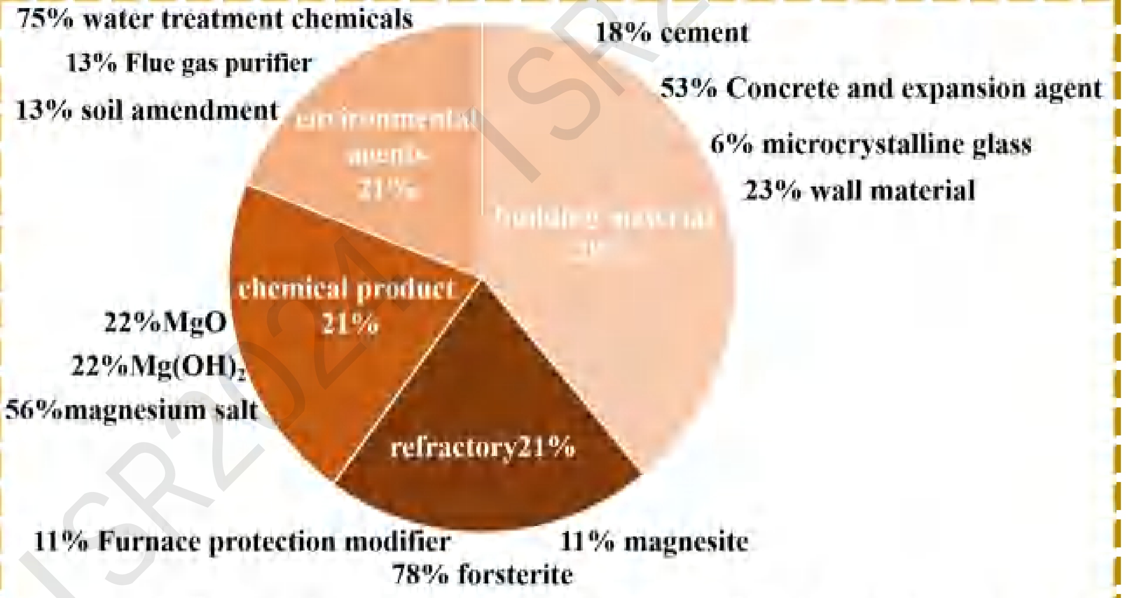
Background

Table 1 Global Magnesite Reserves 2023

country	reserves (1×10^5t)	percentage (%)
America	3500	0.45
Australia	28000	3.64
Austria	4900	0.64
Brazil	20000	2.60
China	58000	7.53
Greece	28000	3.64
India	6600	0.86
Georgia	230000	29.87
Slovakia	120000	15.58
Total	770000	

Magnesite distribution in China





Research literature on comprehensive utilization of magnesite tailings accounts for domain-oriented proportion

Y.F Zhang,L.Y An,X.D Cui.Progress of research on comprehensive utilisation of magnesite tailings[J].Mineral conservation and utilisation,2022,42(06):128-140.

Background

Y.Q Xu, Z.X Zhang, X.J Bai, etc. Progress of research on sorting and purification of magnesite and material preparation[J]. Mineral Protection and Utilisation,2022,42(02):107-113.

Raw material

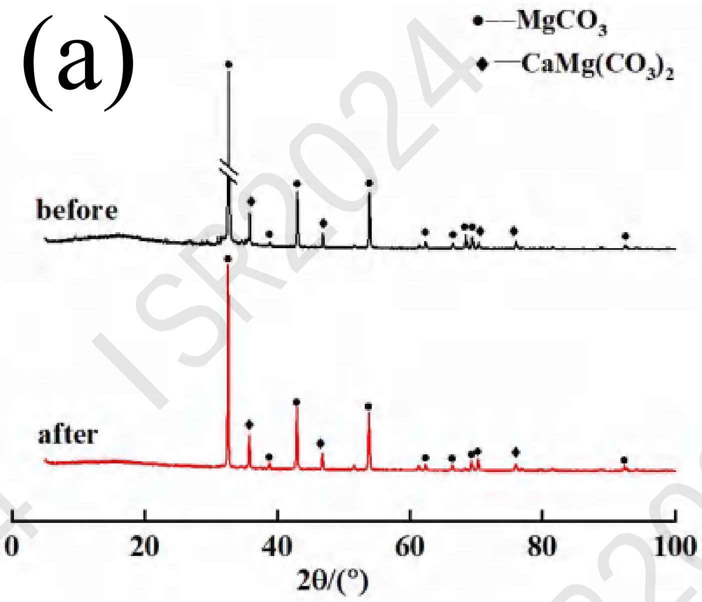
Composition	MgO	SiO_2	Al_2O_3	Fe_2O_3	CaO	P_2O_5
Content (%)	33.9	2.17	0.31	0.841	1.11	0.078

before

Composition	MgO	SiO_2	Al_2O_3	Fe_2O_3	CaO	IL
Content (%)	47.62	0.21	0.04	0.30	0.62	51.1

after

(a)



(b)

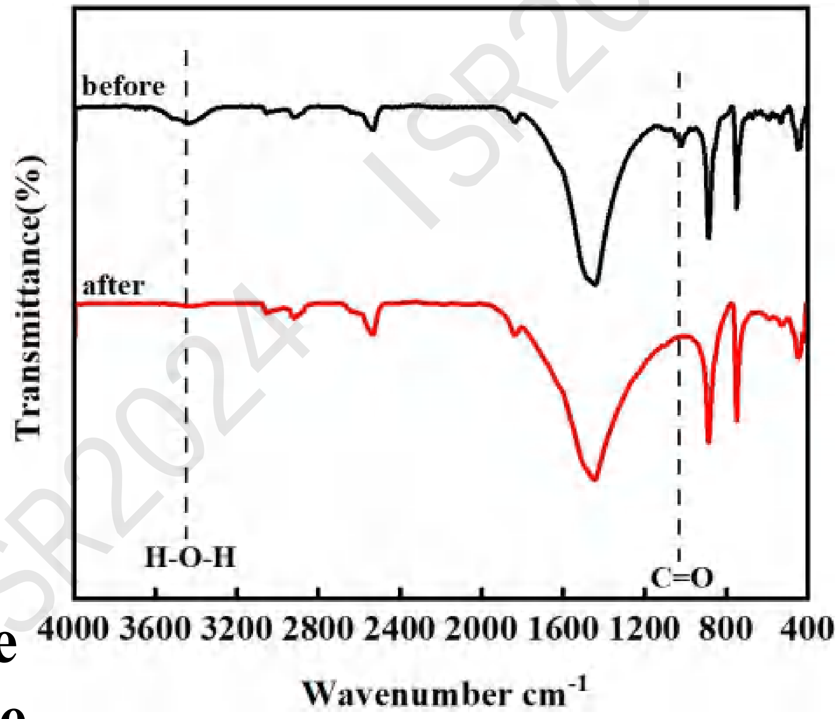
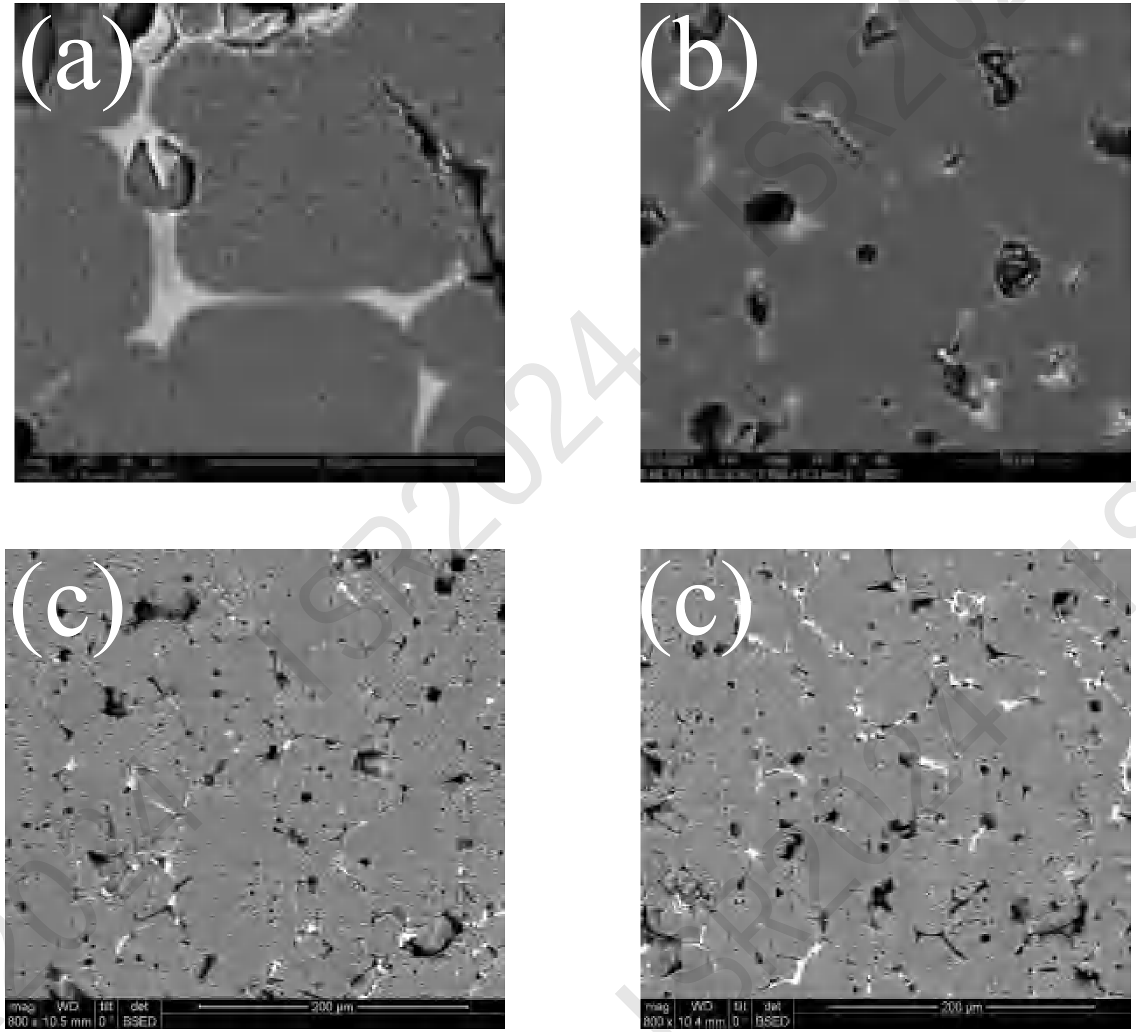


Fig. (a) XRD of flotation magnesite
Fig. (b) FTIR of flotation magnesite

Raw material

microanalysis



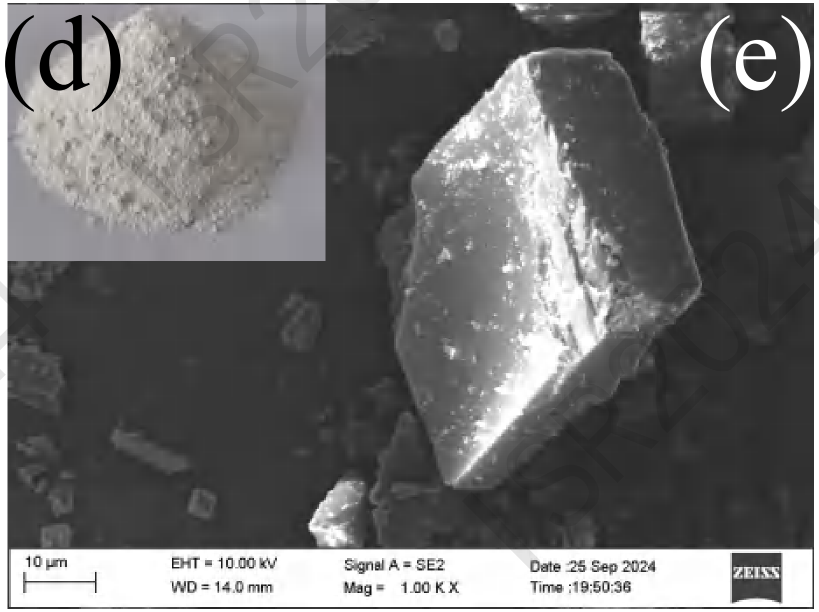
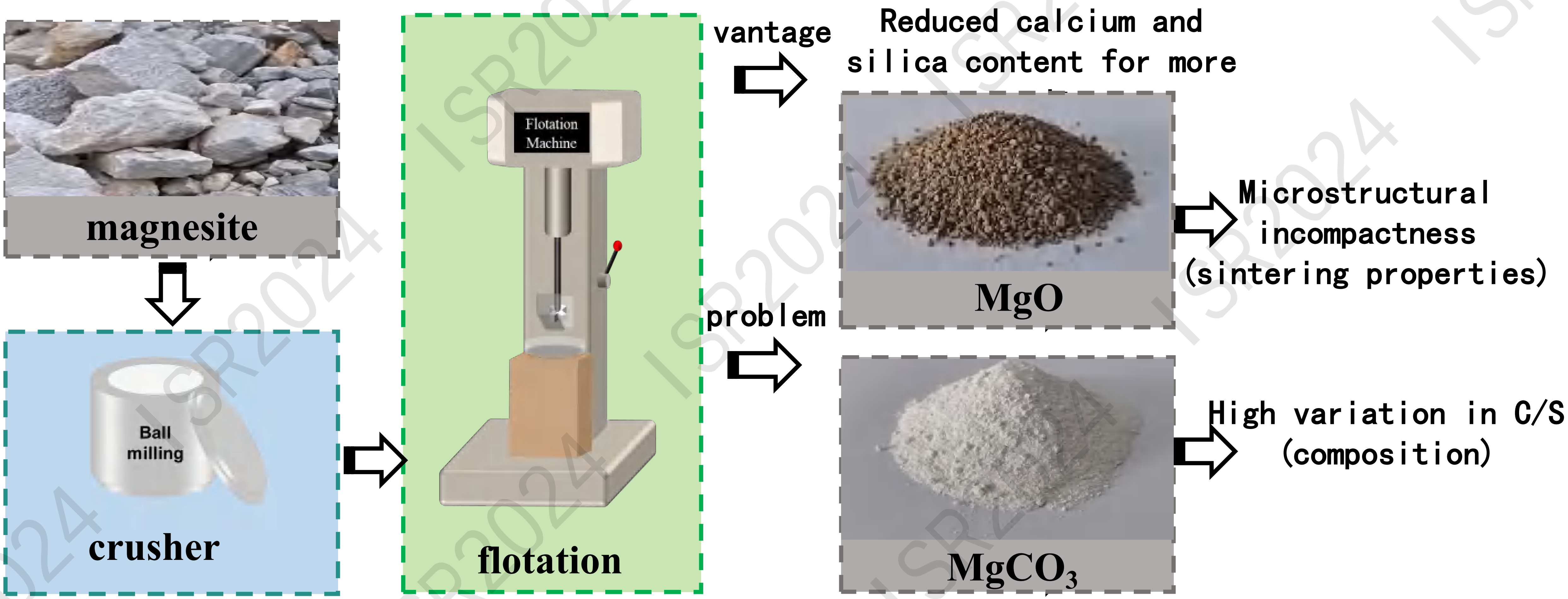


Fig. (a) 96 high purity DBM
Fig. (b) 97 high purity DBM
Fig. (c) DBM by flotation magnesite
Fig. (d) flotation magnesite
Fig. (e) SEM of flotation magnesite

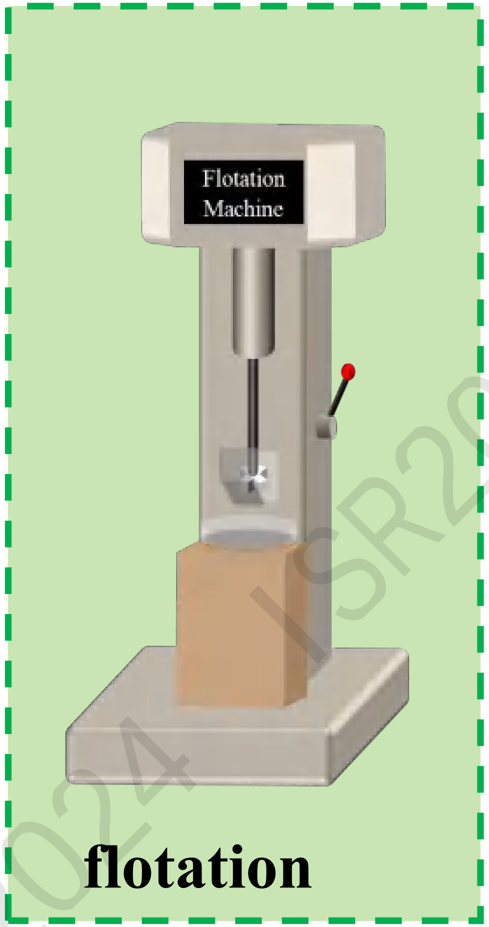
C.Wang, L.Y.Zheng,Y.Y.Zhang,et al. Analysis and comparison of microstructures of magnesia with different production processes[J]. Refractory and Lime,2023,48(06):40-44.

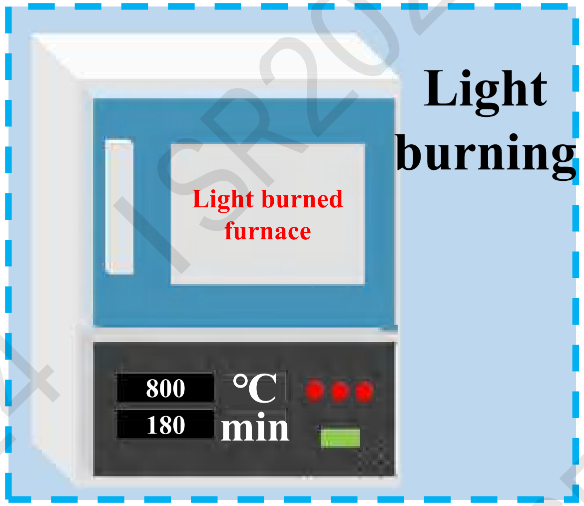
Analysis



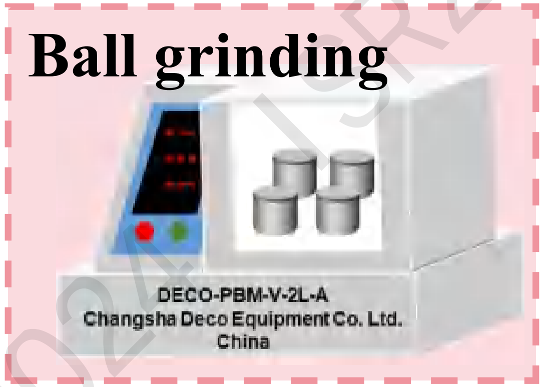
magnesite
Ball milling
crusher
Flotation Machine
flotation
vantage
Reduced calcium and silica content for more
MgO
Microstructural incompactness (sintering properties)
problem
$MgCO_3$
High variation in C/S (composition)

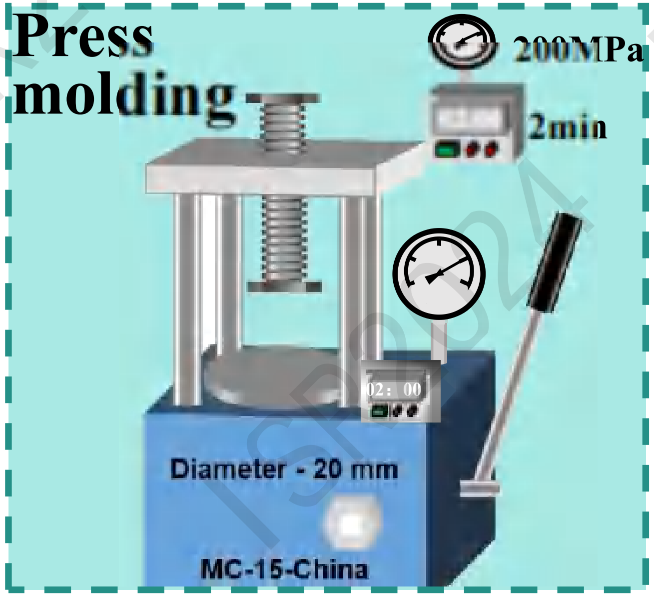
Experiment

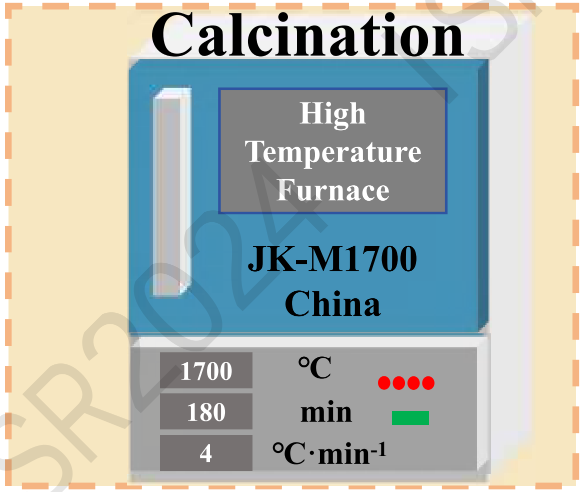




400	℃	500	℃
1、2、3	h	1、2、3	h
600	℃	700	℃
1、2、3	h	1、2、3	h
800	℃	900	℃
1、2、3	h	1、2、3	h
1000	℃	1100	℃
1、2、3	h	1、2、3	h



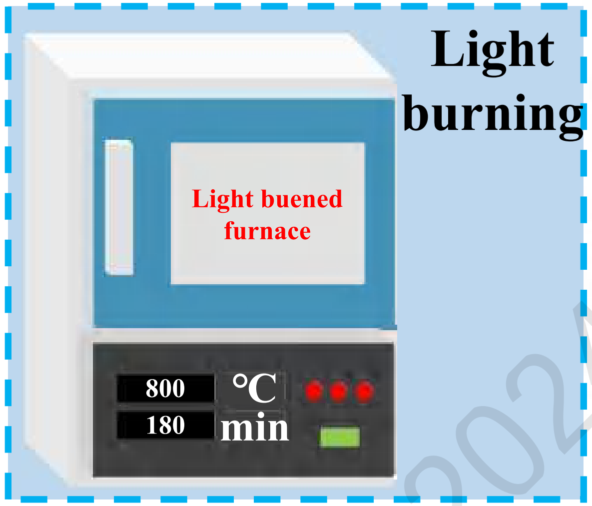




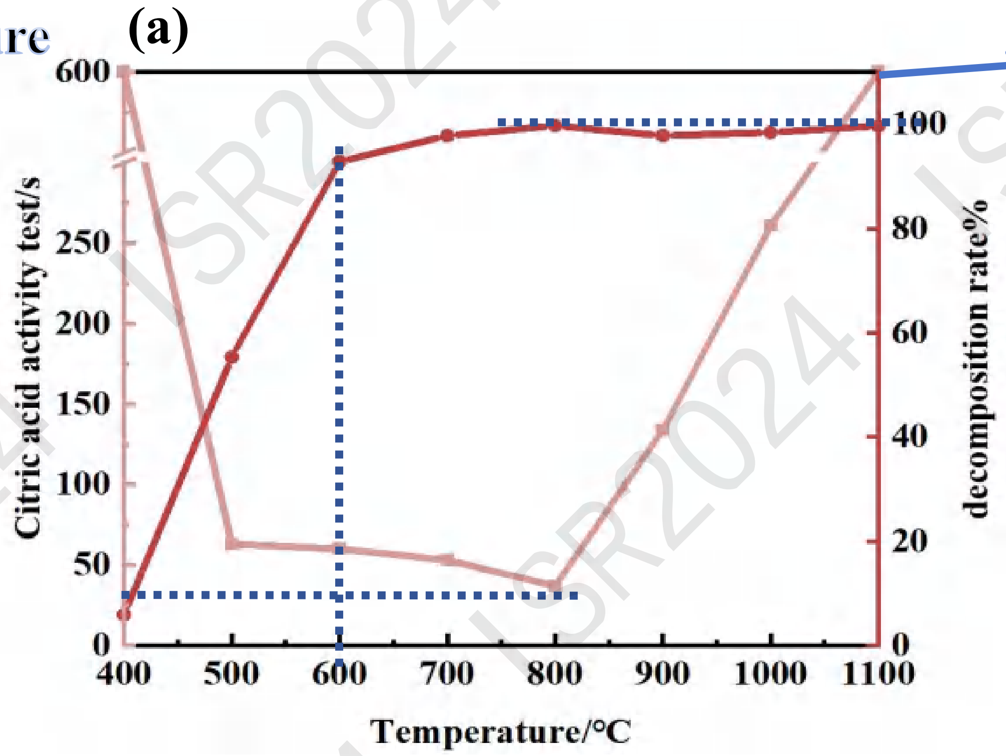
		1700	℃
1500	℃	1、2、3	h
1、2、3	h	1800	℃
		1、2、3	h
1600	℃	1900	℃
1、2、3	h	1、2、3	h

Experiment

Light Burning Temperature



400 ℃	3 h	500 ℃	3 h
600 ℃	3 h	700 ℃	3 h
800 ℃	3 h	900 ℃	3 h
1000 ℃	3 h	1100 ℃	3 h



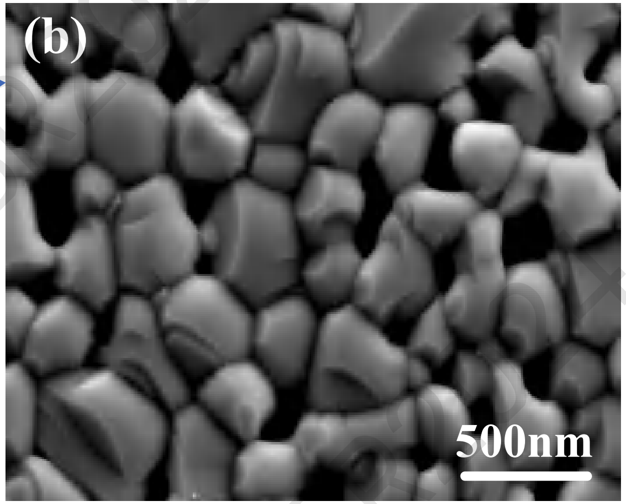


Fig. a) Decomposition rate of flotation magnesite at different light burning temperatures and chemical activity

Fig. b) SEM of MgO obtained at 1100 ℃

The temperature of the light burn≥**800℃**, the flotation magnesite is basically **completely decomposed**.

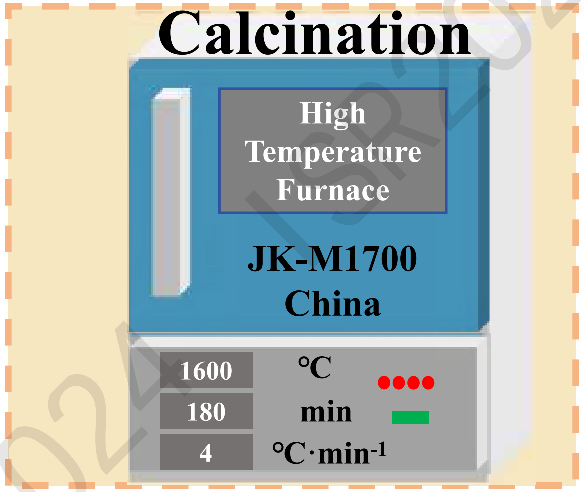
The citric acid activity test of MgO shows a tendency of decreasing and then increasing with the increase of lightly burnt temperature, Lowest citric acid activity test at **800℃**,which the active is **the best.**

Determination of chemical activity： YBT 4019-2020: Calculation of decomposition rate: $\omega = (m_0 - m_x)/(m_0 - m_\alpha) \times 100\%$

Analysis and Results

700	℃	800	℃
1、2、3	h	1、2、3	h
900	℃	1000	℃
1、2、3	h	1、2、3	h

Table 1 Different light burning temperature



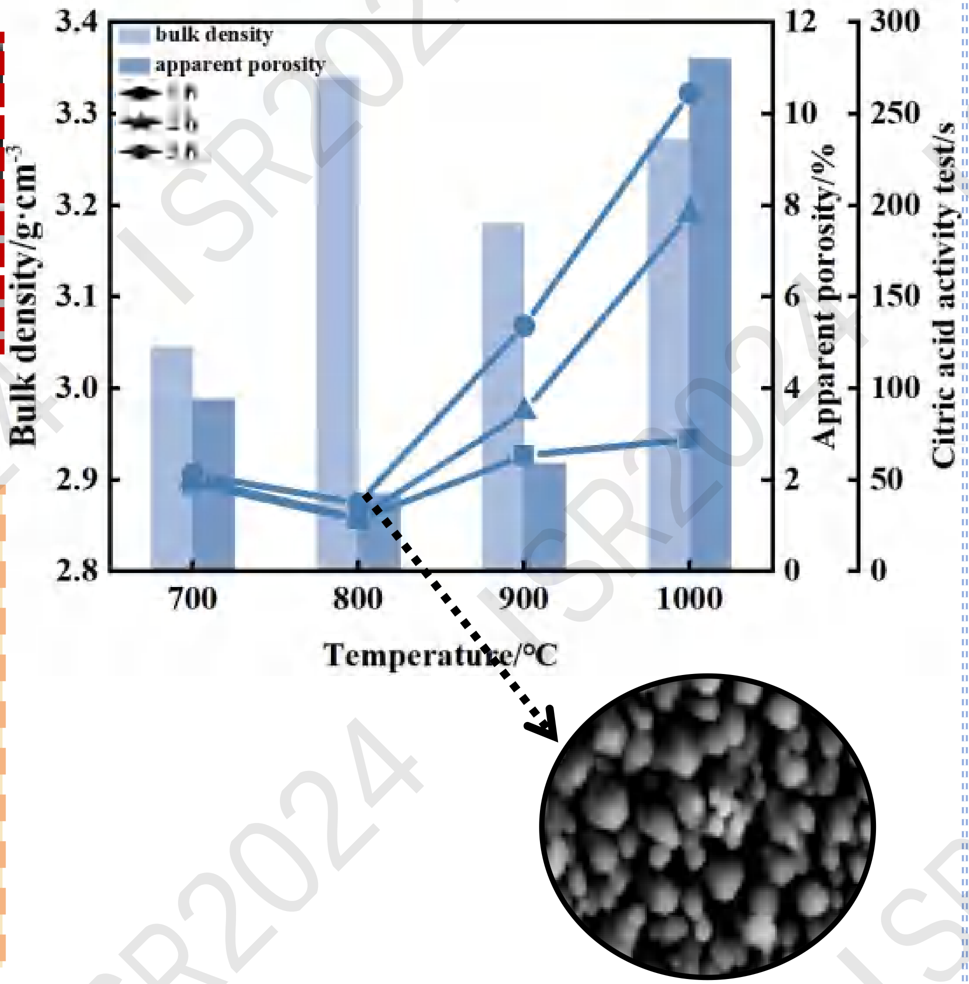


Fig.1 Activity at different temperatures and bulk density detection of magnesium sand from two-step

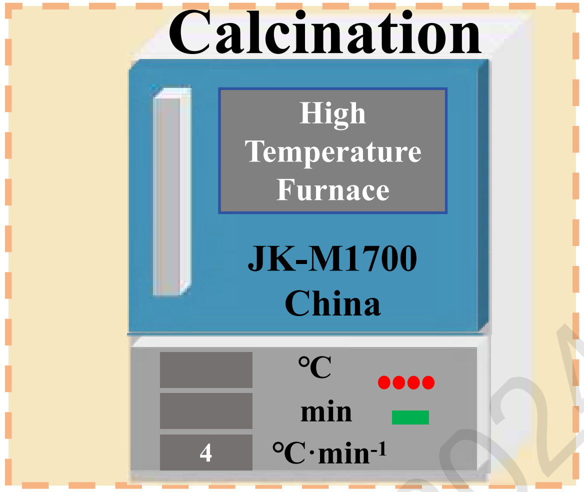
With the time of heat preservation increased, the activity of MgO became lower.

When the light burning temperature is 700 or 800 ℃, the activity of MgO is higher, easy to sinter; when the temperature is **800 ℃**, the **bulk density is the largest**.

With the prolongation of the keep warm time the lattice defects and other problems gradually reduced .So we choose the light burning temperature of **800 ℃ for 3 hours** is more appropriate.

Analysis and Results

Calcination system



1500	℃	1700	℃
1、2、3	h	1、2、3	h
1600	℃	1800	℃
1、2、3	h	1、2、3	h
		1900	℃
		1、2、3	h

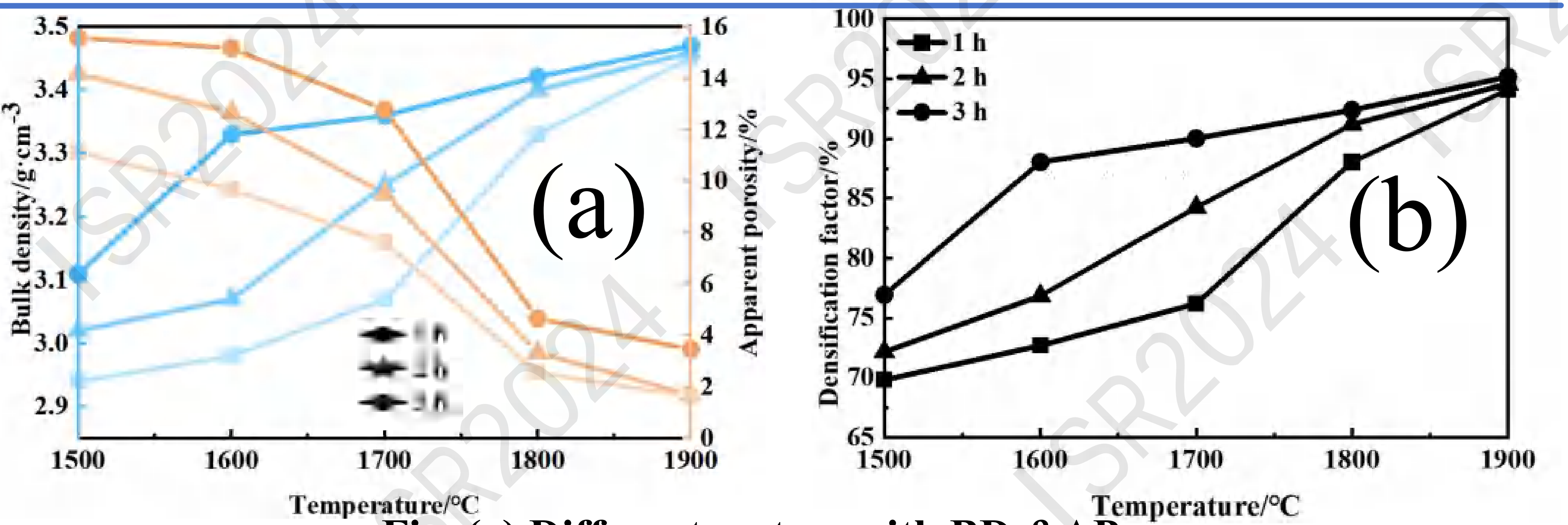


Fig. (a) Different system with BD &AP

Fig. (b) Different system with densification factor

The bulk density of sintered magnesium sand by holding at **1800 ℃ for 2 h is ≥ 3.40 g·cm^{-3}**.

It can be seen that by increasing the sintering temperature and prolonging the keep warm time can help the sintering of magnesium sand products, and with sintering temperature continues increasing, the difference between the bulk density of different keep warm time is smaller.

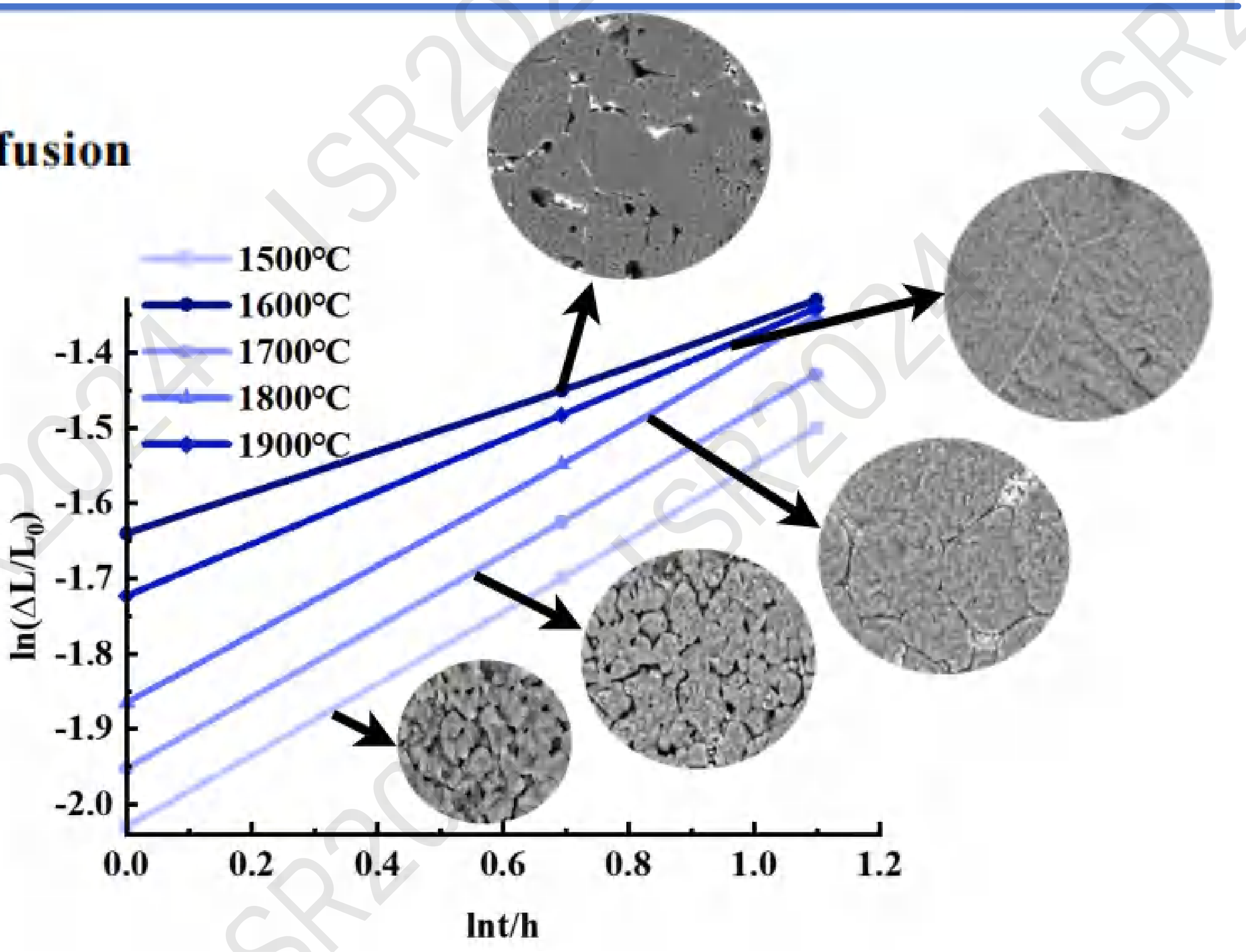
Analysis and Results

Sintering kinetics

Sintering processes controlled by **grain boundary diffusion** or **volume diffsion** with constant temperature rise:

$$ln\ \left(\frac{\Delta L}{L_0}\right) = mlnt + lnD$$

L_0 is the original length of the sample, mm
L is the length of the sample after sintering, $\Delta L = L - L_0$, mm
$\Delta L / L_0$ is the sample shrinkage
t is the sintering time, h
D is a constant associated with sintering



$\ln(L/L_0) \sim \ln t$

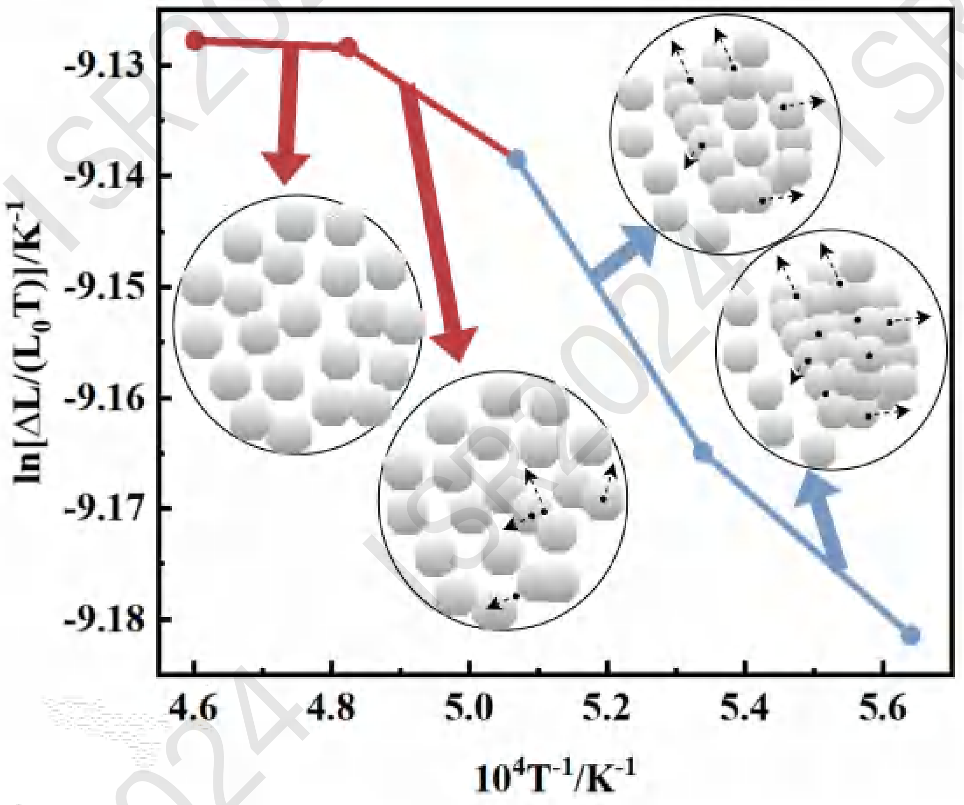
Analysis and Results

Sintering kinetics

According to the sintering model proposed by **Johnson**, the sintering shrinkage as a function of temperature is obtained by taking the logarithmic scale:

$$ln\ \left(\frac{\Delta L}{L_0}/T\right)\ =-\frac{Q}{nRT}+lnM$$

Q activation energy for sintering, J·mol-1
R is is the gas constant gas constant 8.314J·mol-1·K-1
T is the sintering temperature，K
M is a constant associated with sintering



ln[L/(L$_0$/T)]~ 1/T

As the temperature increased, the sintering activation energy decreased from **341.29 KJ/mol**, to **69.6 KJ/mol**, indicating that the higher the sintering temperature, the lower the activation energy.

JOHNSON L. New method of obtaining grain-boundary and surface diffusion coeffieients from sintering data [J]. Journal of Applied Physics, 1969, 40(1) : 192-200.

Thank you

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