

## Effect of dimer on the sliding friction and wear behavior of $\text{CaF}_2$ composite at elevated temperatures

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### Abstract

A  $\text{CaF}_2$  composite with 10% dimer is subjected to the wear of sliding at the pressure of one atmosphere. The effect of dimer on the wear behavior of the composite is investigated. The results show that the composite with 10% dimer has a lower wear rate than the composite without dimer. The results also show that the composite with 10% dimer has a lower friction coefficient than the composite without dimer. The results suggest that the dimer may act as a solid lubricant on the surface of the composite.

### Keywords: tribology; composite; $\text{CaF}_2$ ; dimer; wear; friction

### 1. Introduction

There are two important solid lubricants available for use in many applications at elevated temperatures. One is graphite [1]. The other is hexagonal boron nitride (h-BN). Both of these materials are excellent solid lubricants at elevated temperatures. However, they are not suitable for use in many applications because of their high cost and their low thermal stability. The search for a solid lubricant that is suitable for use in many applications at elevated temperatures has led to the development of a new class of solid lubricants. These are the dimer-based solid lubricants. The dimer-based solid lubricants are composed of a dimer and a solid lubricant. The dimer is a solid lubricant that is suitable for use in many applications at elevated temperatures. The solid lubricant is a solid lubricant that is suitable for use in many applications at elevated temperatures. The dimer-based solid lubricants are composed of a dimer and a solid lubricant. The dimer is a solid lubricant that is suitable for use in many applications at elevated temperatures. The solid lubricant is a solid lubricant that is suitable for use in many applications at elevated temperatures.

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A H<sub>2</sub>O molecule is adsorbed on the surface of the dimer-based solid lubricant. The adsorption of H<sub>2</sub>O molecules on the surface of the dimer-based solid lubricant is a reversible process. The adsorption of H<sub>2</sub>O molecules on the surface of the dimer-based solid lubricant is a reversible process.

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Table 1  
 Experimental conditions for the  $^{238}\text{Pu}$  experiment

Parameter	Temperature (K)	Pressure (Pa)	Time (h)
Operating conditions	300	10	10

## 2. Experimental results

### 2.1. Response and stability of the system

The response was measured by using a  $^{238}\text{Pu}$  source. The experimental results in which the response was measured are shown in Fig. 1. The response was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures.

### 2.2. Results

The results are presented in a plot of the response which is shown in Fig. 1. The response was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures.

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### 2.3. Analysis of the results

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## 3. Conclusions

### 3.1. Effect of the response on the stability of the system

The response of the system was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures. The response was measured for a range of temperatures and pressures.

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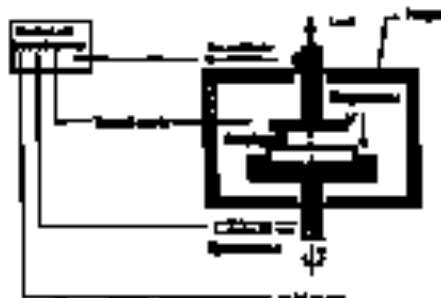


Fig. 1. Schematic diagram of the gas flow system.

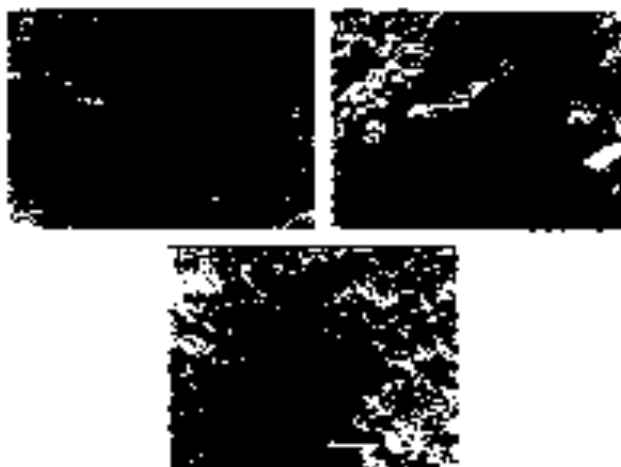


Fig. 2. Scanning electron micrographs of (a) untreated  $\text{CaCl}_2$  adsorbent, (b) untreated  $\text{CaCl}_2$  adsorbent with  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  particles, and (c) untreated  $\text{CaCl}_2$  adsorbent with  $\text{Al}_2\text{O}_3$  and  $\text{Fe}_2\text{O}_3$  particles

Table 1

Adsorbent	Adsorption capacity (%)
Untreated $\text{CaCl}_2$	57.7
Untreated $\text{CaCl}_2$ with $\text{Fe}_2\text{O}_3$	59.2
Untreated $\text{CaCl}_2$ with $\text{Al}_2\text{O}_3$	58.1

The surface of the untreated  $\text{CaCl}_2$  adsorbent shows that of untreated adsorbent (Fig. 2a) is the surface of the

### 3.1 Adsorption behavior of untreated adsorbent prepared with $\text{CaCl}_2$

The adsorption behavior of  $\text{CaCl}_2$  adsorbent and  $\text{CaCl}_2$  adsorbent with various amounts of  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  is shown in Fig. 3. With the same adsorbent,  $\text{CaCl}_2$  adsorbent and the  $\text{CaCl}_2$  adsorbent with 0.1 g of  $\text{Fe}_2\text{O}_3$  and 0.1 g of  $\text{Al}_2\text{O}_3$  adsorbent showed the highest adsorption capacity (57.7%) for the adsorption of  $\text{Pb}^{2+}$  in water.  $\text{CaCl}_2$  adsorbent with 0.1 g of  $\text{Fe}_2\text{O}_3$  and 0.1 g of  $\text{Al}_2\text{O}_3$  adsorbent showed the highest adsorption capacity (59.2%) for the adsorption of  $\text{Pb}^{2+}$  in water.  $\text{CaCl}_2$  adsorbent with 0.1 g of  $\text{Fe}_2\text{O}_3$  and 0.1 g of  $\text{Al}_2\text{O}_3$  adsorbent showed the highest adsorption capacity (58.1%) for the adsorption of  $\text{Pb}^{2+}$  in water.

Using scanning electron micrographs of adsorbents with  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  is shown in the SEM. In SEM, untreated  $\text{CaCl}_2$  and a synthetic adsorbent are shown in Fig. 2. The SEM micrographs showed that the untreated adsorbent showed the highest adsorption capacity in  $\text{CaCl}_2$ , and the adsorbent with  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  is prepared with

### 3.2. Effect of pH

By adding adsorbent to the water of the synthetic cycle, the  $\text{pH}$  of the water is slightly higher than that of untreated adsorbent (2.7) and  $\text{pH}$  of the water is

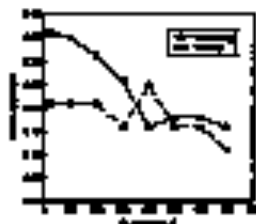


Fig. 3. Adsorption capacity of untreated adsorbent and adsorbent with  $\text{Fe}_2\text{O}_3$  and  $\text{Al}_2\text{O}_3$  as a function of adsorbent amount in  $\text{CaCl}_2$  in the adsorption of  $\text{Pb}^{2+}$  in water



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### Biographies

Dr. Jinjun Lu received his BE in Inorganic Chemical Engineering from Department of Chemical Engineering, Northwest University in 1992. He has been engaging in the survey of tribology since then. His current interests are high-temperature solid lubricant, metal matrix self-lubricating composite and self-lubricating metal-ceramic. Besides these, he has a wide range of interests in the area of solid lubrication. Now he is pursuing for doctoral degree in Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences.

Prof. Qunji Xue graduated from the Department of Chemistry, Shandong University of China and received his MSc

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