

## 反应 $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$ 的非线性化学动力学1: 固相振荡燃烧的实验现象

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**摘要** 在外界环境条件恒定的情况下,反应体系 $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$ 的燃烧过程是不均匀的,燃烧和光强呈周期性的强弱变化,给出了典型的化学振荡现象。本文介绍了 $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$ 体系的固相振荡燃烧配方,对新配方进行了实验,研究了这个体系的固相振荡燃烧现象的非线性特性,分析了固相化学振荡的非线性化学反应动力学机理。

**关键词** [高氯酸铵](#) [镁](#) [重铬酸钾](#) [反应动力学](#) [振荡反应](#) [固相反应](#) [反应机理](#)

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## The nonlinear chemical reaction kinetics of $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$ system

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**Abstract** Under normal circumstances the reaction system of  $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$  does not burn at a constant velocity, it burns oscillatorily. The nonlinear chemical properties of the system are studied in the present paper. New formulas for the solid-phase oscillatory combustion are introduced. In these formulas, the ratio of composition is changed in order to obtain the new oscillatory combustion phenomenon. The experimental results are recorded by X-Y digital recorder and Kodak EM 1020 high speed movement analysis apparatus. The waveforms show that the formula in this study can produce oscillatory combustion. From the experimental study, it can be seen that with the increasing of  $\text{NH}_4\text{ClO}_4$  and Mg contents, the frequency increases. Moreover, the change of the  $\text{K}_2\text{Cr}_2\text{O}_7$  content greatly affects the oscillation frequency. The experiment results and reaction mechanisms are analyzed by the methods of the nonlinear chemical reaction kinetics. It can be seen that oscillatory combustion occurs mainly as a result of the competing reactions among the three phases of Mg with oxygen. 1. Solid-phase Mg(s) reacts with oxygen and releases energy. In open systems, if the energy cannot maintain the temperature of the system, the reaction will stop and combustion ceases. When Mg(s) is at the vapor temperature, if the heat released from phases change of Mg is equal to the heat required for heating the mixture, the temperature is steady, and then the reaction occurs at a smouldering rate. If more heat is generated during the heat production than that consumed, the reaction rate will increase. At this moment there are two states: one is that the production rate of Mg(g) is slower than the consumption rate, and deflagration will not appear; the other is that the production rate of Mg(g) is greater than that of consumed and deflagration appears, or in the vapor state and the temperature is high. From the experiment, it can be seen that, the deflagration time of the reaction is longer than the smouldering 反应 $\text{NH}_4\text{ClO}_4+\text{Mg}+\text{K}_2\text{Cr}_2\text{O}_7$ 的非线性化学动力学1: 固相振荡燃烧的实验现象

**Key words** [AMMONIUM PERCHLORATE](#) [MAGNESIUM](#) [POTASSIUM DICHROMATE](#) [REACTION KINETICS](#) [OSCILLATORY REACTION](#) [SOLID PHASE REACTION](#) [REACTION MECHANISM](#)

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