

Comments on the Isotopic and Chemical Studies of the Thermal Decomposition of Ammonium Nitrate

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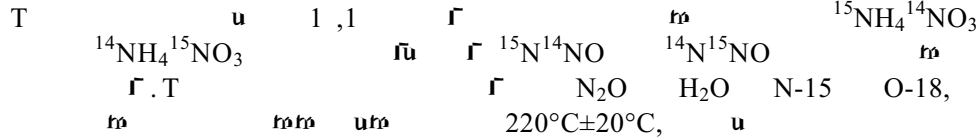
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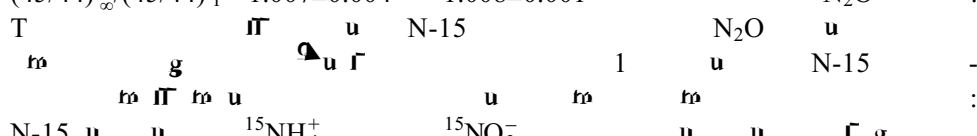
The thermal decomposition of ammonium nitrate (AN, NH_4NO_3) is a complex process. The decomposition reaction is given by equation (1):



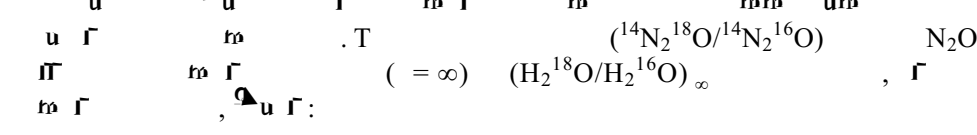
In our previous work [1], we reported the isotopic composition of the products of the thermal decomposition of ammonium nitrate. The isotopic composition of the reactant is given by equation (2):



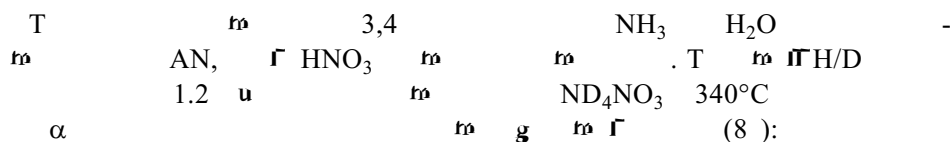
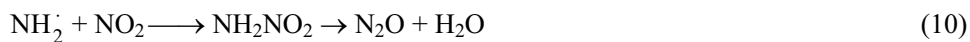
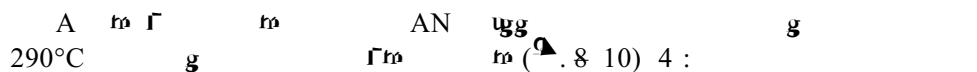
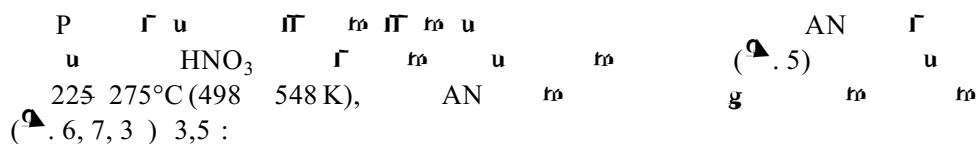
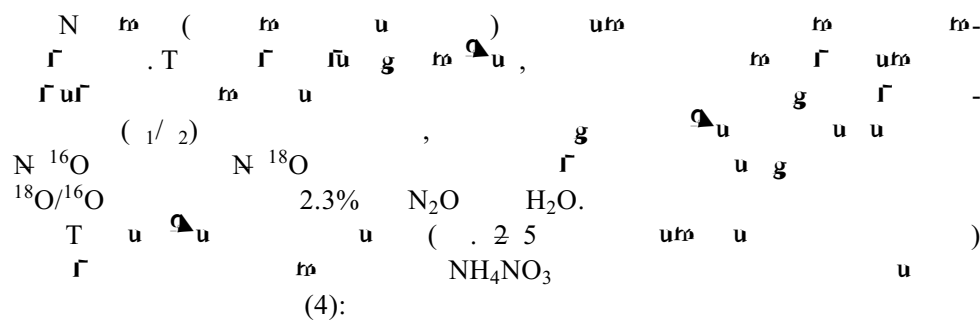
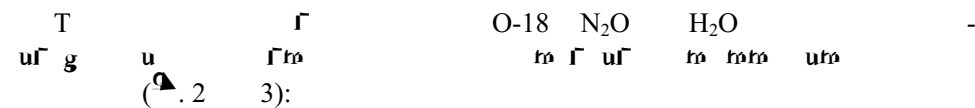
The isotopic composition of the products is given by equation (3):

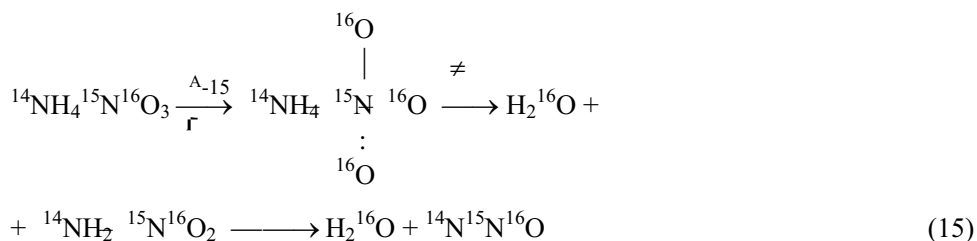
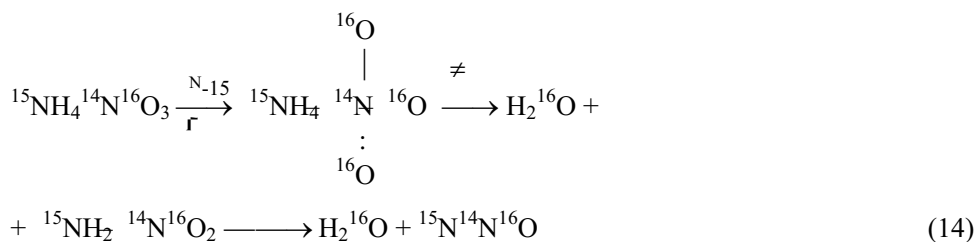
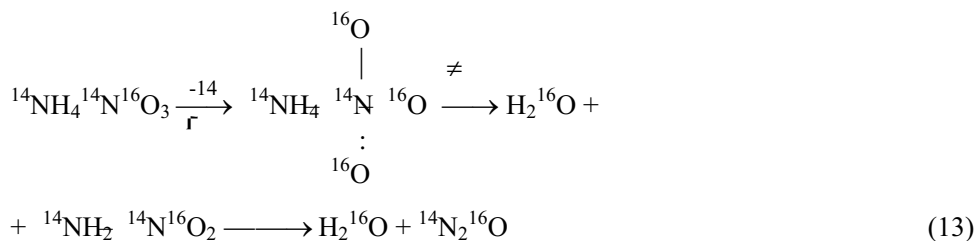
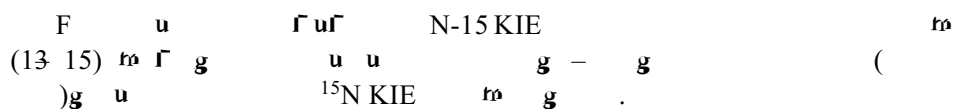
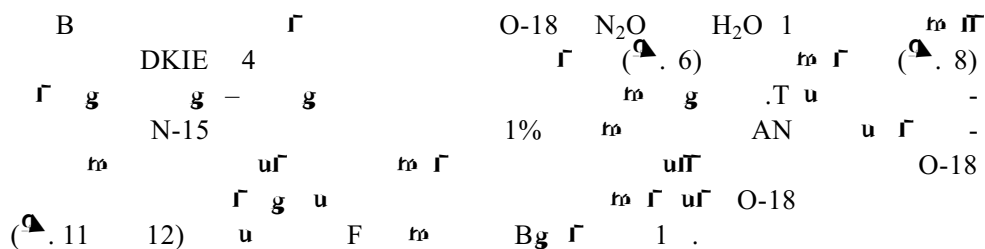


The isotopic composition of the products is given by equation (4):



$$\begin{aligned} (\text{N}_2^{18}\text{O}/\text{N}_2^{16}\text{O})/(\text{H}_2^{18}\text{O}/\text{H}_2^{16}\text{O})_{\infty} &= (212.6 \pm 0.2 \times 10^{-5}) / (208.0 \pm 0.3 \times 10^{-5}) = 1.022 \\ &= (212.5 \pm 0.5 \times 10^{-5}) / (207.6 \pm 0.2 \times 10^{-5}) = 1.024 \\ &= 1.023 \pm 0.003 \text{ (mean value)} \end{aligned}$$





A m Γ (1%) g N₂O m :

$$^{15}\text{N}^{14}\text{N}^{16}\text{O} + ^{14}\text{N}^{15}\text{N}^{16}\text{O} / ^{14}\text{N}_2^{16}\text{O} = (^A_{-15}) ^{14}\text{NH}_4^{15}\text{N}^{16}\text{O}_3 +$$

$$+ (^N_{-15}) ^{15}\text{NH}_4^{14}\text{N}^{16}\text{O}_3 / (^{-14}) ^{14}\text{NH}_4^{14}\text{N}^{16}\text{O}_3 \quad (16)$$

S , g Γ g D N-15 , (^N_{-15}) = (^{-14}),

$$\frac{^{15}\text{N}^{14}\text{N}^{16}\text{O} + ^{14}\text{N}^{15}\text{N}^{16}\text{O}}{^{14}\text{N}_2^{16}\text{O}} = \frac{(^A_{-15}) / (^{-14}) + 1}{(^N_{-15})} \frac{^{14}\text{NH}_4^{15}\text{N}^{16}\text{O}_3}{^{14}\text{NH}_4^{14}\text{N}^{16}\text{O}_3} \quad (17)$$

A m Γ m AN:

$$^{14}\text{NH}_4^{15}\text{N}^{16}\text{O}_3 + ^{15}\text{NH}_4^{14}\text{N}^{16}\text{O}_3 / ^{14}\text{N}_2^{16}\text{O} = R^N_{45}(^{15}\text{N}) + R^A_{45}(^{15}\text{N}) =$$

$$= R^{m45}(=\infty) \quad (18)$$

$$R^N_{45} = ^{15}\text{NH}_4^{14}\text{N}^{16}\text{O}_3 / ^{14}\text{NH}_4^{14}\text{N}^{16}\text{O}_3 = ^{15}\text{N}^{14}\text{N}^{16}\text{O} / ^{14}\text{N}_2^{16}\text{O} = \infty$$

$$R^A_{45} = ^{14}\text{NH}_4^{15}\text{NO}_3 / ^{14}\text{NH}_4^{14}\text{NO}_3 \cong ^{14}\text{N}^{15}\text{N}^{16}\text{O} / ^{14}\text{N}_2^{16}\text{O} = \infty$$

I Γ u N-15 AN:

$$R^{m45}(,1\%) = (^A_{-15}) / (^{-14}) + 1 \quad 1/2 R^{m45}_{=\infty} \quad (19)$$

$$(^A_{-15}) / (^{-14}) + 1 = 2 R^{m45}_{(1\%)} / R^{m45}_{=\infty} \quad (20)$$

T u

$$(^{-14}) / (^A_{-15}) = 1 / 2 R^{m45}_{(1\%)} / R^{m45}_{=\infty} - 1 \quad (21)$$

U g Δ u (21) m Γ m (R_{=∞}^{m45}/R_(1%)^{m45})

1.008 1.007 1 (^{-14}) / (^A_{-15}), N-15 m

1.015±0.001.

T u m Γ fū KIE g g g g

m g u I.E. I m AN u u N-14 N-15

Γ g u u Γ N-15 KIE 1.015. T Γ fū u

u Γ ¹⁵N KIE m Γ ¹⁵N ¹⁶O u u . T m g

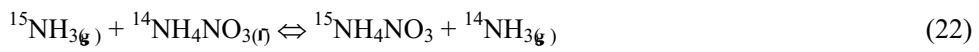
g Γ ¹⁵N ¹⁶O , (H¹⁶O...¹⁵NO₂)[≠],

m Γ T.S.(≠) -

m g g - g . T Γ Γ g Γ , u N-15

u u g - g AN(g Δ .4).

A Γ N-15 HNO₃ (g) u)
 Γ u N-15 u -
 Δ u Γ u NH₂NO₂ u Γ u u
¹⁵N KIE N₂O u (0.7, 3). T u , Γ u N-15
 u u ¹⁵N ¹⁶O , u
 m g u Δ u Γ u m ¹⁵N
 g u (0.4).
 T ¹⁵N g Δ u Γ NH₃ NH₄⁺NO₃⁻
 10 , , m Γ NO NO₂ 11 , , Γ NO
 HNO₃ 12- Γ g -
 Γ Γ (0.22-24):



$\alpha = K = 1.034$ 25°C 10 ,



$K = 1.0417$ 25°C (Γ u Γ); 1.0146 200°C; 1.0075 400°C;
 1.0044 600°C 11 , , .



$K = 1.045 \pm 0.01$; \bar{u} : 1.055 25°C (NO 10 M. HNO₃) m 12 .

T NH₄NO₃(m Γ) HNO₃(g)
 Γ Γ m Γ (m Γ Γ), u Γ g -
 Γ u Γ m H¹⁴NO₃/H¹⁵NO₃ m Γ . T -
 Γ u g NO₃⁻ Γ 13-g . T
 Γ g H¹⁵NO₃ 14- . I m u
 u m Γ u Γ -
 m g Δ u Γ u u u Γ -
 g Γ Δ u u m Γ u Γ -
 g Δ u Γ Γ g m Γ u Γ .
 T u Γ u Γ Γ 11 . T Γ m Γ
 Γ Γ u Γ m g u m Γ u Γ (¹⁴N)/ (¹⁵N)
 1.014 ± 0.001, m m Γ m 15 ,
 u Γ Γ g m Γ Γ m Γ .

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