

FORMAT FOR FULL PAPER
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**ULTRAFAST HYDROGEN MIGRATION IN ALLENE INDUCED
BY AN INTENSE FEMTOSECOND LASER FIELD**

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Abstract. Ultrafast hydrogen migration in allene ($\text{CH}_2=\text{C}=\text{CH}_2$) induced by intense laser fields was investigated by Coulomb explosion coincidence momentum imaging (CMI)...

Key word: *Hydrogen migration, Allene, Intense laser field.*

I. INTRODUCTION

During the past few years, an ultrafast hydrogen migration process within a molecule in intense laser fields has been an attractive research theme, not only because of the findings that hydrogen atoms (or protons) move extremely rapidly within a molecule, but also their potential applicability for controlling chemical bond breaking processes [1, 2]...

II. EXPERIMENTS

The schematic diagram of the experimental setup used in this experiment is shown in Fig. 1. The light source used in the experiments was a Ti:Sapphire femtosecond laser system (Pulsar 5000, Amplitude Technologies)...

III. RESULTS AND DISCUSSION

Figure 1 shows the recorded time-of-flight (TOF) mass spectrum of the ionic species generated from C_3H_4 in the intense laser field...

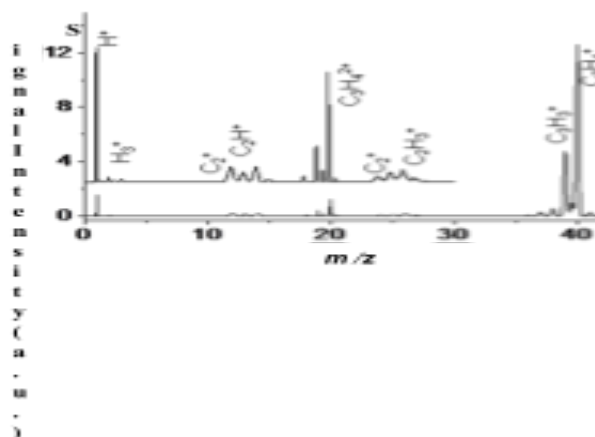


Fig.1. Time-of-flight mass spectrum of allene in an intense laser field (40 fs, $2 \times 10^{13} \text{ W/cm}^2$).

The momentum imaging maps of CH_m^+ ($m=1-3$) appearing in coincidence with $\text{C}_2\text{H}_{4-m}^+$ are shown in Figs. 3a-3c, which represent the two-body Coulomb explosion pathways Eq. (1).

$$I(\theta) = 1 + \sum_L b_L \prod_{k=1}^{L/2} \frac{(1/\tau\omega)^2 + (2k-1)^2}{(1/\tau\omega)^2 + (2k)^2} P_L(\cos \theta_m^0) P_L(\cos \theta) \quad (L=2, 4, 6) \quad (6)$$

where P_L denotes the Legendre polynomial and b_L reflects the angular distribution of the molecular principal axis of the parent molecules with respect to the laser polarization direction.

Table 1. The $\langle \cos^2 \theta \rangle$ values of the fragment ions, H_n^+ and the parameters obtained by least-squares fits of Eq. (6).

Explosion pathways	θ_m^0/deg	$\tau\omega$	τ/ps	$\langle \cos^2 \theta \rangle$
$\text{C}_3\text{H}_3^+ + \text{H}^+$ ($n=1$)	29(2)	>5.0	>1.9	0.37
$\text{C}_3\text{H}_2^+ + \text{H}_2^+$ ($n=2$)	23(2)	>5.0	>1.9	0.38
$\text{C}_3\text{H}^+ + \text{H}_3^+$ ($n=3$)	12(4)	3.2 (1.1)	1.2(4)	0.39

IV. CONCLUSION

The two-body and three-body Coulomb explosion of allene induced by an ultrafast intense laser field has been investigated by using the coincidence momentum imaging method...

V. ACKNOWLEDGMENTS

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REFERENCES

- [1] A. Hishikawa, H. Hasegawa, and K. Yamanouchi, *J. Electron Spectrosc. Relat. Phenom.* Vol. **141**, 2004, pp. 195-200.
- [2] T. Kato, K. Yamanouchi, *J. Chem. Phys.* Vol. **131**, 2009, pp.164118(1-14).
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