

## DEHYDROGENATION OF ETHYLENE: SPECTROSCOPY AND STRUCTURES OF $\text{La}(\text{C}_2\text{H}_2)$ AND $\text{La}(\text{C}_4\text{H}_6)$ COMPLEXES

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Hydrogen elimination is observed in the reaction of laser-ablated La atoms and ethylene ( $\text{C}_2\text{H}_4$ ) in a pulsed molecular beam source. Dehydrogenated products,  $\text{La}(\text{C}_2\text{H}_2)$  and  $\text{La}(\text{C}_4\text{H}_6)$ , are identified by time-of-flight mass spectrometry and studied by pulsed-field-ionization zero-electron kinetic energy spectroscopy and density functional theory calculations.  $\text{La}(\text{C}_2\text{H}_2)$  is determined as a triangle ( $\text{C}_{2v}$ ) in the  $^2\text{A}_2$  ground electronic state, where La binds with  $\text{C}_2\text{H}_2$  in a two-fold mode ( $\eta^2$ ).  $\text{La}(\text{C}_4\text{H}_6)$  is identified as a diligand species with La being sandwiched between  $\text{C}_2\text{H}_2$  and  $\text{C}_2\text{H}_4$ , each in a two-fold binding mode, and the complex is in the  $^2\text{A}_1$  ground electronic state. The adiabatic ionization energies of  $\text{La}(\eta^2\text{-C}_2\text{H}_2)$  and  $\text{La}(\eta^2\text{-C}_2\text{H}_2)(\eta^2\text{-C}_2\text{H}_4)$  are measured to be 41174(5) and 39405(5)  $\text{cm}^{-1}$ , respectively.  $\text{La}^+\text{-C}_2\text{H}_2$  and  $\text{La}^+\text{-C}_4\text{H}_6$  stretching and C-H bending frequencies of the corresponding ions are also determined, and the vibrational assignments are confirmed with deuterated ethylene measurements.