DEHYROGENATION OF ETHYLENE: SPECTROSCOPY AND STRUCTURES OF La(C_2H_2) AND La(C_4H_6) COMPLEXES

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Hydrogen elimination is observed in the reaction of laser-ablated La atoms and ethylene (C_2H_4) in a pulsed molecular beam source. Dehydrogenated products, La(C_2H_2) and La(C_4H_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. La(C_2H_2) is determined as a triangle (C_{2v}) in the $^2A_2$ ground electronic state, where La binds with C_2H_2 in a two-fold mode (η^2). La(C_4H_6) is identified as a diligand species with La being sandwiched between C_2H_2 and C_2H_4, each in a two-fold binding mode, and the complex is in the $^2A_1$ ground electronic state. The adiabatic ionization energies of La(η^2-C_2H_2) and La(η^2-C_2H_2)(η^2-C_2H_4) are measured to be 41174(5) and 39405(5) cm^{-1}, respectively. La$^+$-C_2H_2 and La$^+$-C_4H_6 stretching and C-H bending frequencies of the corresponding ions are also determined, and the vibrational assignments are confirmed with deuterated ethylene measurements.