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Chiral Sensitivity in Electron-Molecule Interactions¹

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All molecular forms of life possess a chiral asymmetry, with amino acids and sugars found respectively in L- and D-enantiomers only. The primordial origin of this enantiomeric excess is unknown. One possible explanation is given by the Vester- Ulbricht hypothesis [1], which suggests that left-handed electrons present in beta-radiation, produced by parity-violating weak decays, interacted with biological precursors and preferentially destroyed one of the two enantiomers. Experimental tests of this idea have thus far yielded inconclusive results [2]. We show direct evidence for chirally-dependent bond breaking through a dissociative electron attachment (DEA) reaction when spin-polarized electrons are incident on gas-phase chiral molecules [3]. This provides unambiguous evidence for a well-defined, chirally-sensitive destructive molecular process and, as such, circumstantial evidence for the Vester-Ulbricht hypothesis. I will also present the results of our systematic study of the DEA asymmetry for different chiral halocamphor molecules. Three halocamphor molecules were investigated: 3-bromocamphor ($C_{10}H_{15}BrO$), 3-iodocamphor ($C_{10}H_{15}IO$), and 10-iodocamphor. The DEA asymmetries collected for bromocamphor and iodocamphor are qualitatively different, suggesting that the atomic number of the heaviest atom in the molecule plays a crucial role in the asymmetric interactions. The DEA asymmetry data for 3- and 10-iodocamphor have the same qualitative behavior, but the 10-iodocamphor asymmetry is about twice as large at the lowest energies investigated, so the location of the heavy atom in the camphor molecule also affects the asymmetries. This work was performed at the University of Nebraska-Lincoln.

[1] T.L.V. Ulbricht and F. Vester, *Tetrahedron* **18**, 629 (1962).

[2] See, e.g., W.A. Bonner, *Chirality* **12**, 114 (2000).

[3] J.M. Dreiling and T.J. Gay, *Phys. Rev. Lett.* **113**, 1181 (2014).

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