DETECTION OF FeCN ($X^4\Delta_i$) IN THE CIRCUMSTELLAR ENVELOPE OF IRC+10216

L. N. ZACK, D. T. HALFEN, and L. M. ZIURYS, *Department of Chemistry, Department of Astronomy, and Steward Observatory, University of Arizona, Tucson, AZ, 85721.*

A new interstellar molecule, FeCN ($X^4\Delta_i$), has been detected in the envelope of the carbon-rich AGB star, IRC+10216. This work is the first definitive detection of an iron-bearing molecule in the interstellar medium, and is based on newly-measured rest frequencies. Eight successive rotational transitions of this linear free radical in the lowest spin ladder, Ω = 7/2, were observed at 2 and 3 mm using the Arizona Radio Observatory (ARO) 12 m telescope. Three transitions appear as single, unblended features at the 1-2 mK level and exhibit characteristic IRC+10216 line profiles; one had previously been observed with the IRAM 30 m telescope. Two other transitions are partially blended, but exhibit distinct emission at the FeCN frequencies. The remaining transitions are either completely contaminated, or are too high in energy. Comparison of the ARO and IRAM data suggests a source size for FeCN in IRC+10216 of $30''$, indicating an outer shell distribution, as expected for a free radical. The column density derived for FeCN in this object is N_{tot} = 4.0x10^{11} cm^{-2} with a rotational temperature of T_{rot} = 21 K The fractional abundance of this molecule is [FeCN]/[H_2] = 3x10^{-10}, comparable to that of AlNC and KCN in the outer envelope. FeCN is likely formed by gas-phase reactions of Fe^+ or neutral iron, which has a significant gas-phase abundance in the outer shell. The detection of FeCN is further evidence that, aside from silicon, metal cyanides/isocyanides dominate the chemistry of refractory elements in IRC+10216.