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Dust and Chemical Abundances of the halo Planetary Nebula K648 in M15

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We performed detailed chemical abundance analysis of the extremely metal-poor ([Fe/H]=–2.45) halo planetary nebula (PN) K648 in M15 based on the Subaru/HDS spectrum, *HST*/FOS UV-spectrum, and *Spitzer*/IRS mid-infrared spectrum. We detected over 130 gas emission-lines and we determined the abundances of 10 elements. We report the first estimates of the F, Cl, and Fe abundances in K648. The F enhancement ([F/H]=+0.98) is comparable to that in the halo PN BoBn1 (Otsuka et al. 2010, 723, 658). The C/O ratio (12.2) indicates that K648 is an extremely C-rich PN. We improved the Ne abundance by considering the Ne^+ abundance derived from the [Ne II] 12.8 μm. The chemical abundances of K648 are close to those predicted by an AGB nucleosynthesis model for the initially 1.25-1.5 $M_\odot$ stars with the metallicity Z=0.005 $Z_\odot$ and the ^{13}C pocket mass of 2×10^{-3} $M_\odot$. We found that K648 shows carbon dust features such as the 6-9 μm and 11.3 μm polycyclic amorphous hydrocarbon (PAH) bands and the broad 11 μm feature attributed to large PAH clusters or silicon carbide. Using the observed spectra and the *HST*/WFPC2 and *Spitzer*/IRAC/MIPS photometry data, we constructed the spectral energy distribution model to investigate the current evolutionary status of the central star and estimate the gas and dust masses. The progenitor mass of 1-1.5 $M_\odot$ estimated by plotting the derived luminosity and effective temperature of the central star on the H-R diagram suggests that K648 experienced binary evolution, because the main-sequence turn-off point for M15 corresponds to $\sim$0.8 $M_\odot$.