U-Zr metallic fuels cladded in Fe-alloys are being considered for application in advanced Sodium-Cooled Fast Reactor (SFR) that can recycle the U-Zr fuels and minimize the long-lived actinide waste. To understand the complex fuel-cladding chemical interaction between the U-Zr metallic fuel with Fe-alloys, a systematic multicompontent diffusion study was carried out using solid-to-solid diffusion couples. The U-10wt.%Zr vs. pure Fe diffusion couples were assembled and annealed at temperatures, 630, 650 and 680°C for 96 hours. Development of microstructure, phase constituents, and compositions developed during the thermal anneals were examined by scanning electron microscopy, electron probe microanalysis, transmission electron microscopy and X-ray energy dispersive spectroscopy. Complex microstructure consisting of several layers that include phases such as U6Fe, UFe2, ZrFe2, α-U, β-U, Zr-precipitates, χ, ε and λ were observed. Multi-phase layers were grouped based on phase constituents and microstructure, and the layer thicknesses were measured to calculate the growth constant and activation energy. The local average compositions through the interaction layer were systematically determined, and employed to construct semi-quantitative diffusion paths on isothermal U-Zr-Fe ternary phase diagrams at respective temperatures. The diffusion paths were examined to qualitatively estimate the diffusional behavior of individual components and their interactions. Furthermore, selected area diffraction analyses were carried out to determine, for the first time, the exact crystal structure and composition of χ, ε and λ-phases. The χ, ε and λ-phases were identified as Pnma(62) Fe(Zr,U), I4/mcm(140) Fe(Zr,U)2, and I4/mcm(140) U3(Zr,Fe), respectively.