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Chemical pressure tuning of URu2Si2 via isoelectronic substitution of Ru with Fe

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We have used specific heat and neutron diffraction measurements on single crystals of $URu_{2-x}Fe_xSi_2$ for Fe concentrations $x \leq 0.7$ to establish that isoelectronic substitution of Ru with Fe acts as "chemical pressure" P_{ch}. Neutron diffraction reveals a sharp increase of the uranium magnetic moment at $x = 0.1$, reminiscent of the "hidden order" (HO) to large moment antiferromagnetic (LMAFM) phase transition in URu_2Si_2. Using the unit cell volume, and the isothermal compressibility κ_T for URu_2Si_2, we determine P_{ch} as function of x. The resulting temperature T-chemical pressure P_{ch} phase diagram for $URu_{2-x}Fe_xSi_2$ is in good agreement with the established temperature T-external pressure P phase diagram of URu_2Si_2. Thus, $URu_{2-x}Fe_xSi_2$ provides a new opportunity to study the close relationship between the HO and LMAFM phases with methods that cannot be used under pressure, and may shed some new light on the on the elusive order parameter of the HO.

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