Effect of chemical substitution on valence state transition in EuPd$_2$Si$_2$

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EuPd$_2$Si$_2$ undergoes a valence state transition of Eu$^{3+}$ → Eu$^{2+}$ near $T_v = 142$ K in the temperature-dependent DC field magnetization measurements. In addition, the DC M-vs-T measurements show a minor shift of $\approx 1$ K in the $T_v$ with 6 T applied field. Furthermore, temperature-dependent powder and single-crystal XRD measurements showed that EuPd$_2$Si$_2$ has an anisotropic thermal expansion across $T_v$. To explore the effect of chemical substitution on valence state transition, doping at Pd site and Si site has been done. All the doped samples crystallize in the same tetragonal I4/mmm structure while the transition temperature moved significantly with the minimal doping of 5-10 %. The $T_v$ moves to the lower temperature side with Ge doping at Si site while it moves toward higher side with Ni doping at Pd site which is confirmed via detailed DC magnetization measurements. Similar to the pristine sample, all the doped samples exhibit anisotropic thermal expansion across $T_v$.

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