Czochralski growth of Yb- and Eu-based intermetallic compounds

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In recent years, Yb and Eu compounds have increasingly become the focus of basic research in solid-state physics. A variety of exciting phenomena can be studied on Yb compounds, such as quantum criticality or superconductivity [1-3]. Both, Yb and Eu can assume different valence states in compounds. In the case of Eu, for example, compounds exist in which Eu is divalent as Eu^{2+} and thus magnetic with a large atomic radius or trivalent as Eu^{3+} and thus nonmagnetic with a smaller atomic radius. Furthermore, Eu can also occur with non-integer valence, i.e. intermediate valence. The strong change in cell volume at the valence transition opens up the possibility to study elastic properties, in particular the coupling of electronic and lattice degrees of freedom [4]. Such strong coupling effects and the breakdown of Hooke's law were recently found in an organic charge transfer salt [5].

Due to the high vapor pressure of the elements at high temperatures and their strong tendency to oxidation, both Yb and Eu-based compounds are usually grown in closed crucibles, in the presence of a temperature gradient. Recently, we have already shown that the growth of the ferromagnetic compound $YbNi_4P_2$ is possible by the Czochralski method under an argon pressure of 20 bar [6]. Here we present the growth of the intermetallic compound $EuPd_2Si_2$ [7,8] as well as the system doped with Ge and Au, respectively, by the Czochralski method from the levitated melt [9]. The obtained grown specimens usually contain mm^3 large single crystalline domains. The analysis of the Ge-doped system shows that the valence transition temperature, T_v~160 K, of the pure system is shifted to lower temperatures upon substitution and transitions to antiferromagnetic order from about 20% nominal Ge substitution [10].

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