Vacancy Superstructures in Intermetallic Compound $Pr_{1.33}Pt_4Ga_{10}$

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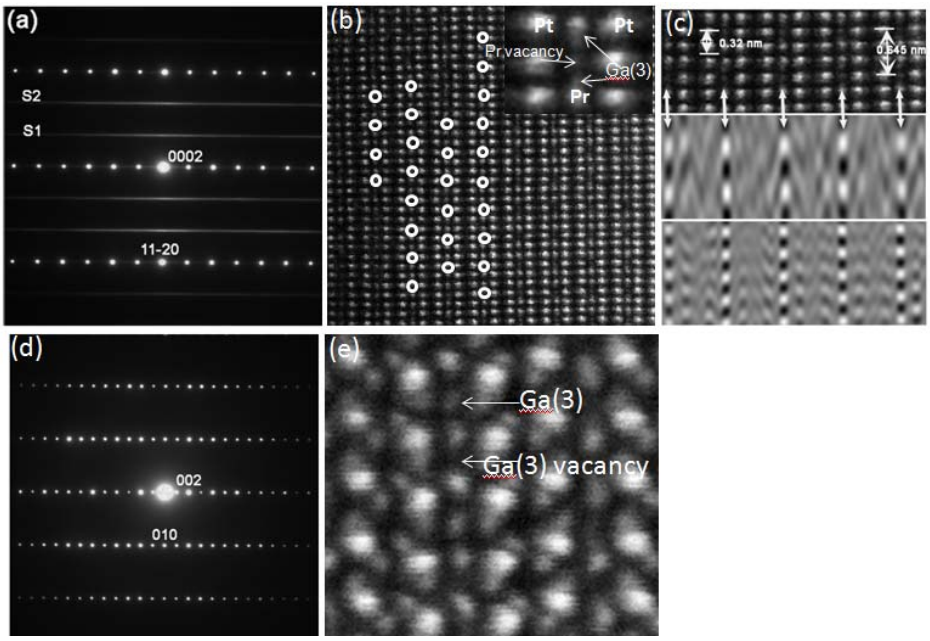
The heavy-fermion materials that have strong hybridization between conduction electrons and f-electrons exhibit interesting physical properties under chemical doping, pressure and magnetic field. One class of such compounds is the intermetallic compounds with f-electron elements. The layered structure of these new rare-earth intermetallic compounds has attracted more attention due to superconductivity. $Pr_{1.33}Pt_4Ga_{10}$ is a layered crystal that has been synthesized and has shown weak ferromagnetism or canted antiferromagnetism at 7.8 K [1]. The crystal structure of $Pr_{1.33}Pt_4Ga_{10}$ consists of two alternating AB layers, with A being the Pt_2Ga_4 double layer, and B the Pr_2Ga_3 layer [1].
The A layer Pt_2Ga_4 has fully occupied Pt and Ga atoms, but the B layer Pr_2Ga_3 consists of partially occupied Pr and Ga(3) atoms with site occupancies of 0.708(7) and 0.322(7), respectively.

In this report, we show the TEM study of the vacancy structures of the $Pr_{1.33}Pt_4Ga_{10}$ crystals. TEM work was carried out on a probe-aberration-corrected sub-Ångstrom-resolution JEOL JEM-ARM200cF microscope operated at 200kV. The vacancy superstructure shows clearly projected along [1-100] in Fig. (a) to (c). The STEM Z-contrast image shows Pr vacancies at every two occupied Pr columns (circled in Figure (b)), together with the occupied Ga(3). But they are disordered along c-axis, determined by the diffraction streaks and the atomic resolution STEM Z-contrast image. The diffraction streak S2 with periodicity of 3.20 Å is due to the ordering of the Pr vacancy, and the diffraction streak S1 of 6.45 Å corresponds to the distance of the Pr vacancy and Ga(3) vacancy. The vacancy structure does not show ordering along [11-20] direction (Figure(d)), implying the one-dimensional ordering on the ab-plane.



Acknowledgements
This work is supported by NSF-DMR-0654118 and the State of Florida, and the Florida State University Research Foundation.

References
[1] Sau Doan Nguyen, et al., to be submitted to Inorganic Chemistry.