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Magnetoresistance and Hall coefficient in V_xGe_{1-x} single crystal

(VGe 단결정의 자기저항과 홀 계수)

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Substituting transition metals such as V, Cr, Mn, Fe, Co and Ni into semiconductors have been of interest because of its unique electrical and magnetic properties. It was reported that the magnetoresistance(MR) ratio of CrGe was 1.7 % and 1 4 % at 120 K in fields of 0.5 and 5 T, respectively.[1] The MR ratio of FeGe was 19% at 180K.[2] The electrical resistivity of CrGe changed according to Cr concentration.[3] In this talk, we report transport properties of V-doped Ge single crystals with several different V concentrations. The carrier densities and mobilities will be determined from Hall measurement.

We have grown V_xGe_{1-x}($x \leq 8$) single crystals using the vertical temperature gradient solidification method. For the preparation of single-crystalline V_xGe_{1-x}, we used high-purity germanium(Ge) and vanadium(V) powders as starting materials with a particle size of < -325mesh to maximize the surface area and thereby enhance the reaction kinetics. First, the powers were weighted and loaded into thick-walled quartz ampoules. After the ampoules were evacuated ($<10^{-6}$ Torr) and sealed, it loaded into a vertical furnace, and heated slowly to from single-phase V_xGe_{1-x}. The heating cycle was 30℃/h to 1050℃ followed by 170-h soak. For single-crystal growth, the temperature was slowly cooled at 1℃/h to a point below the melting temperature (937 ℃ for Ge) and thereafter at 100 ℃/h.

The observed powder XRD pattern of V_xGe_{1-x} showed the diamond structures. The lattice constants of V_xGe_{1-x} were larger compared with that of pure Ge. Transport properties were characterized by using PPMS (Physical Property Measurement System, Quantum Design).We have observed that electrical resistivity decreased with V concentration and rapik resistivity increase, 10^5 times, at low temperature.The MR ratio of V_2Ge_{98} at 5K, V_4Ge_{96} at 77K and V_8Ge_{92} at 77K are 106 %, 161 %and 10 %, respectively.

References

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