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Figure of merit for thermoelectric power generation estimated from enhanced mobility in [100] oriented β-$FeSi_2$ thin film HIROFUMI KAKEMOTO, Tokyo Institute of Technology, HAJIME SHIBATA, AIST, SATOSHI WADA, TAKAAKI TSURUMI, Tokyo Institute of Technology — β-$FeSi_2$ has been attracted to be applied to the thermoelectric device, for instance, the Seebeck coefficient shows the maximum value about 500^oC that it is good for thermoelectric power generation. However low figure of merit (Z) has been reported about $5x10^{-4}$ K^{-1}. The Z is represented as $m^{*2/3}(\mu/\kappa_{ph})$, where m^*, μ and κ_{ph} are effective mass, mobility and thermal conductivity, respectively. Although κ_{ph} is good for thermoelectric power, low μ has been reported as polaronic-conduction in β-$FeSi_2$ crystal. In 3D electron density distribution of β-$FeSi_2$ crystal, Si layer in the crystal shows covalent bonding network with Si atoms, and it suggests the new possibility for enhancement of μ. In this report, the objective is to exhibit the possibility for enhancement of Z in order to control the crystallographic orientation of β-$FeSi_2$ crystal by means of film formation. β-$FeSi_2$ thin film was prepared on Si(100) substrate using molecular beam epitaxy method. The crystallographic orientation of sample showed about 80% of [100] direction from x-ray diffraction pattern. The transport properties were investigated using Hall measurement with van der Pauw electrode configuration. The resistivity and μ were also measured, and they were compared with β-$FeSi_2$ polycrystal. In addition, enhancement of Z was estimated using above formula.

Hirofumi Kakemoto
Tokyo Institute of Technology

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