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Effects of Implantation Heating on Exfoliation of InP

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The effect of self-heating during 150 keV hydrogen implantation at a dose of 2.5 and 5×10^{16} H_2^+/cm^2 on the exfoliation of InP is investigated. For material implanted without controlled cooling, significant heating during the implantation prevented subsequent layer transfer. The failure to exfoliate the layer in this case is attributed to the loss of hydrogen and the inability to form platelet type defects at a high temperature. Additionally, the damage profile observed by transmission electron microscopy in the uncooled sample extends from the projected range to the surface of the substrate. In contrast, the implant damage and defects of InP cooled to –20°C are well confined to a single layer at the projected range with a thickness of about 150 nm. This thinner damage distribution is believed to be able to trap more effectively the hydrogen. This in turn, allows greater coalescence of the hydrogen and the platelet defects leading to exfoliation. The successful exfoliation of III-V materials is more sensitive to implant conditions than in the case of Si possibly due to the significantly lower thermal conductivity in III-Vs, which will ultimately lead to greater target heating during implantation.

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