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Millisecond Flash Lamp Annealing and Application for SiGe-HBT

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A 200 mm flash lamp annealing (FLA) prototype was developed beside the EU project DOTSEVEN, named after the f_{max} target of 0.7 THz. Among different experiments n-type Si (100) wafers (8-12 Ωcm) were implanted with Germanium ($5*10^{14}$/cm²; 15 keV) followed by Boron (B) ($2*10^{15}$/cm²; 1 keV) [1]. FLA with 20 J/cm² results in a suppressed B diffusion (Fig.1a) with concurrent higher activation (Rs = 174 Ω/sq) compared to spike annealing (SPA) at 1020°C (Rs = 348 Ω/sq). The second experiment is based on a model HBT with B base prepared by LPCVD. A FLA with 27 J/cm² reduces the profile broadening by a factor of four compared to SPA at 1020°C (Fig.1b). The combination of the high activation and low dopant diffusion of the FLA process and the low deactivation of a backend with low thermal budget allowed us finally to meet the project targets. An experimental SiGe HBT technology featuring f_T / f_{max} / BV_{CEO} = 505 GHz / 720 GHz / 1.6 V and a minimum CML ring oscillator gate delay of 1.34 ps was developed [2].

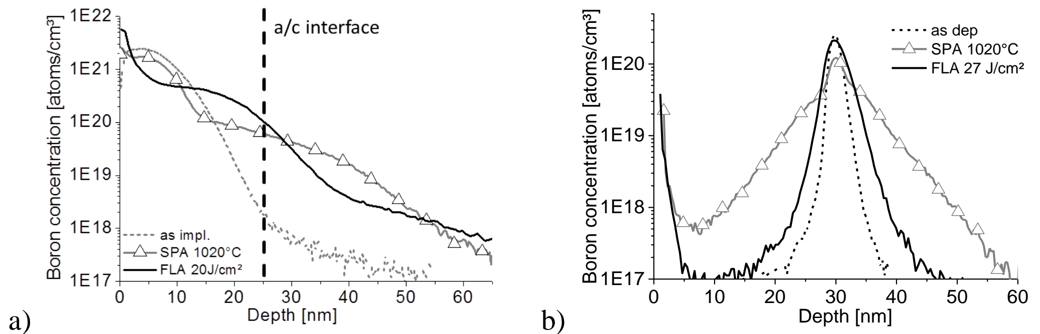

Figure 1: Comparison of Boron SIMS depth profiles after SPA and FLA of a) implanted Boron and b) model HBT structure with Boron base

References

[1] A. Scheit et al. (IIT 2014), pp. 1-4
[2] B. Heinemann et al. (IEDM 2016), pp. 3.1. (2016)