HELMHOLTZ ZENTRUM
DRESDEN ROSSENDORF

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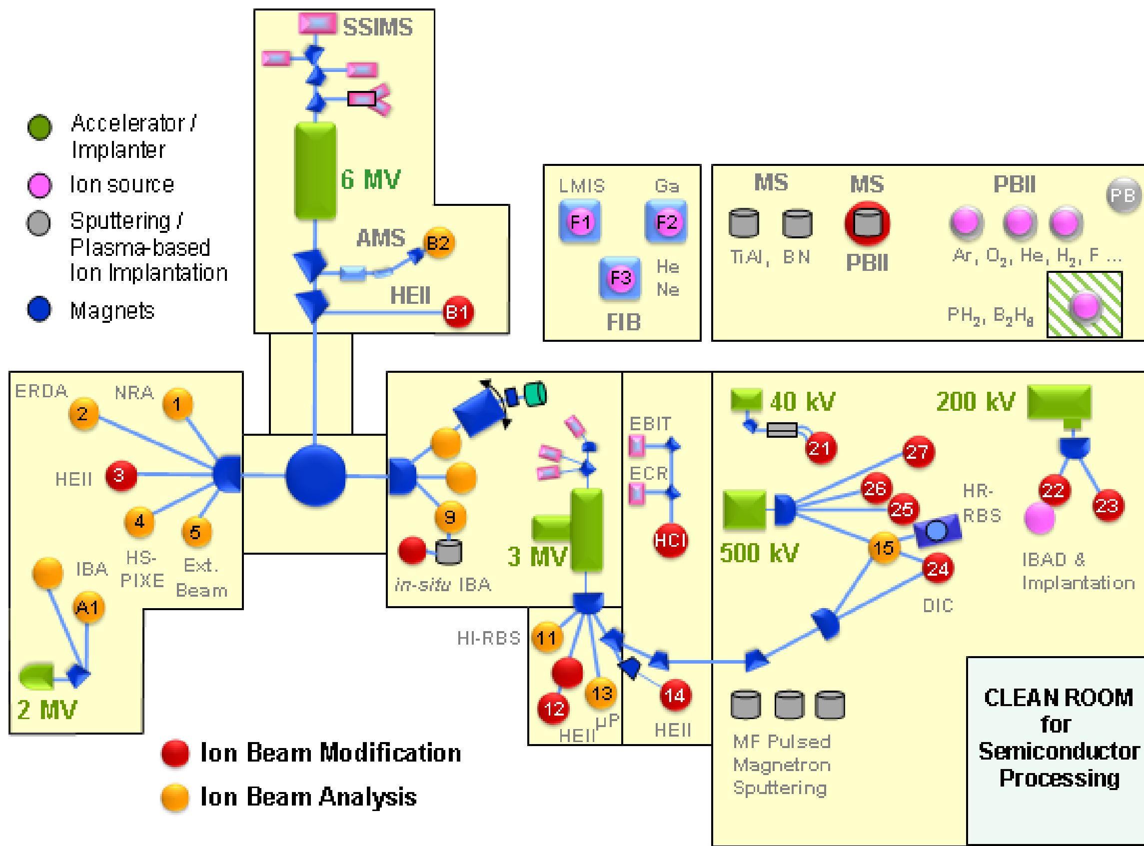
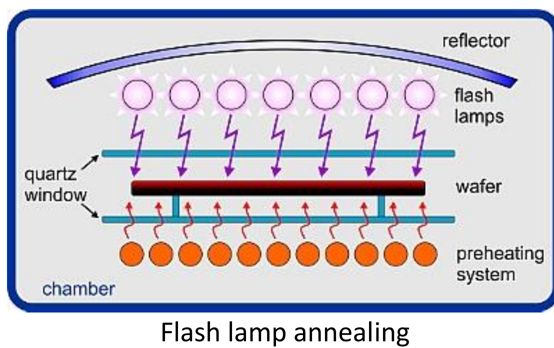
The department of Semiconductor Materials is working on pushing the doping limit in group IV semiconductors like Si, Ge, GeSn and III-V compound semiconductors e.g. GaN and GaAs by ion implantation and sub-second annealing. It is equipped with tools for ultra-fast annealing and thin film deposition as well as with cutting-edge devices for the electrical, optical and magnetic investigation of materials. We are working in close collaboration within HZDR including the Ion Beam Center (IBC) and Positron annihilation lifetime spectroscopy group at ELBE. Our research related with Group IV semiconductors can be outline as the follows.

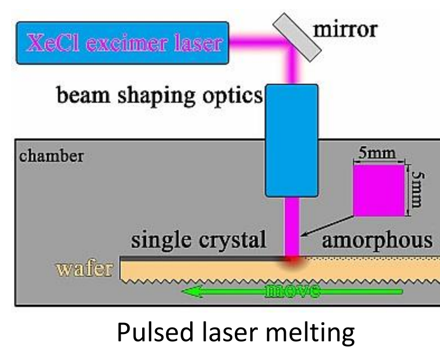
(1) Hyperdoping in Ge and GeSn: by P ion implantation and flash lamp annealing, we increase the doping concentration above 10^{20} cm^{-3}. By using positron annihilation, we also understand the limit of n-type doping in Ge. Flash lamp annealing in milliseconds can dissolve the P4V defects and minimize the diffusion of P, leading to the high activation.
(2) Strain engineering for GeSn films: GeSn films on virtual substrates are generally experienced an in-plane compressive strain, which does not favor the direct bandgap formation. This strain can be tailored by doping with P and by pulsed laser melting.
(3) Hyperdoping Si with deep level impurities: doping Si with deep level impurities can largely modify its intrinsic bandgap, resulting in photoresponse in Si in the infrared and middle infrared range.



Ion beam facilities at Ion Beam Center / Helmholtz-Zentrum Dresden-Rossendorf



Flash lamp annealing



Pulsed laser melting