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# PS2-20: Manufacturing and Characterization of Ultra Thin and Bent Silicon Crystals for Studies of Coherent Interactions with Negatively Charged Particle Beams

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In the last years, thanks to innovative techniques for crystals design and fabrication, based on silicon micromachining, it was possible to realize bent crystals for beam manipulation through coherent interactions, thin enough to avoid the loss of deflection efficiency caused by dechanneling, while maintaining the crystal structure perfectly intact. The realization of such thin bent crystals has opened the way to the investigation of all the coherent interactions phenomena in bent crystals well known for positively charged particles also for the case of negatively charged particles. Such investigation have been performed at the external lines of SPS with hundred-GeV negative pions and electrons [1].
While at CERN energies (a few hundred GeV) the interest in negatively charged beam manipulation is mainly connected with halo collimation for future linear e± colliders, a particular interest in such phenomena is present also at lower energies (~ GeV), for the realization of a periodically bent crystal for miniature electron crystalline undulator. However, because dechanneling scales with beam energy, the technology for bent crystal fabrication need to be pushed to its extreme limit, from the 2 mm long bent crystals for CERN applications, we reduced crystal length along the beam to 30 μm for experiments carried at MAMI [2].
We produced such crystals starting from a SOI bonded wafers, adopting proper revisitations of silicon micromachining techniques such as low pressure chemical vapour depositions, photolithography and anisotropic chemical etching.
The crystals realized were mounted onto mechanical holders, which allow to properly bend the crystal and to reduce unwanted torsions. Crystallographic directions and crystal holder design are optimized in order to excite quasi-mosaic effect [3] of the (111) planes
Prior to experimenting the crystal on particle beams a full set of characterizations were performed. Infrared interferometry were used to measure crystal thickness with accuracy of a few nm. White-light interferometer is employed to characterize surface deformational state and its torsion. High-resolution X-rays diffraction, were employed to precisely measure the crystal bending angle along the beam.
Manufactured crystals were recently installed at the MAMI Mainz MIcrotron to steer sub-GeV electrons [2] (thickness 30.5 μm, bending angle 905 μrad), and at SLAC, to deflect an electron beam in the 1 to 10 GeV range [4] (thickness 60 μm, bending angle 402 μrad).

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