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Growth method dependent purity of silicon crystals for ET-mirrors

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The Einstein Telescope (ET) is a future 3rd generation gravitational wave observatory in Europe and crystalline silicon is under investigation to be used for mirrors. For the semi-transparent ET interferometer mirrors, large Si crystals [1] with ultrahigh purity are needed to minimize thermal noise (low laser light absorption and mechanical loss).
The defect structure and purity of the volume crystals are determined by the growth method. The crucible-free floating zone (FZ) method allows to grow high-purity single crystals with limited diameter, while crystals grown by the Czochralski (Cz) method exhibit in general more impurities due to the contact between the melt and the crucible, but they can be grown with larger diameter.
These differences in the growth method dependent purity level will be discussed and ideas for reducing crucible erosion by using travelling magnetic fields during the Cz-growth will be presented.

References:
[1] Frank M. Kießling et al.: "Quasimonocrystalline silicon for low-noise end mirrors in cryogenic gravitational-wave detectors", Phys. Rev. Research 4 (2022), 043043

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