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Float zone silicon fibers for suspension application in Einstein Telescope

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Monocrystalline silicon fibers are a promising candidate for suspending silicon test masses in gravitational-wave detectors. The excellent thermal and mechanical properties of crystalline silicon enable stable support of heavy mirrors and efficient extraction of laser-induced heat. Moreover, silicon's exceptional material behavior at cryogenic temperatures aligns well with the operational requirements of the Einstein Telescope (ET), which will function under such conditions. As-grown monocrystalline silicon fibers are particularly attractive for suspension applications, as they are both in bulk and surface free from cracks and surface defects (e.g., dislocations), ensuring high tensile strength.
In our research, we explore crucible-free crystal growth methods for fabricating fibers suitable for mirror suspensions in the ET. We present recent results using conventional float zone (FZ) and pedestal techniques to produce thin, monocrystalline silicon fibers with circular cross-sections. Special focus is given to reducing the fiber diameter from 3 mm to smaller dimensions. These crucible-free techniques are also successfully applied to fabricate fibers with customized shapes to facilitate attachment to silicon mirrors and mounts. Our latest developments in this area will be also discussed.

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