perfection of the grown crystal was assessed along the length of the boule using high-resolution X-ray diffraction (HRXRD), and it was found that the grain boundaries that were present in the seed crystal were stopped gradually from propagating into the bulk crystal by necking. The UV–vis transparency of the crystal region having best crystalline perfection (region#4) was found to be higher. Photoluminescence (PL) spectra revealed that a crystal region (region#5) that was found to contain vacancy (point) defects by HRXRD yielded the maximum PL intensity because of color centers at the vacancies. The dielectric properties were also studied over a wide range of frequency.

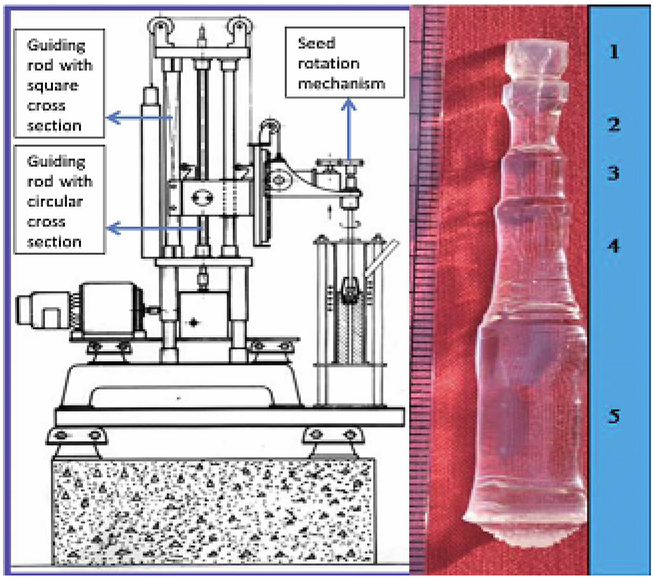

Figure 10: Schematic of the home-made Czochralski crystal puller and (b) grown LiF single crystal

2.7 Effect of double wall crucible design on benzimidazole single crystals grown by the VBT

Benzimidazole, a potential nonlinear organic crystal was found to grow by the standard VBT melt method. However, due its low melting point and softness being an organic material these crystals grows with grain boundaries[10]. Recently we have tried to grow these with a double walled VBT ampoule and found that the crystalline quality is much better than that grown with single wall ampoule by the same method[9]. The modified VBT ampoule has double-wall with a slope and a narrow open portion at the end of the inner wall. The designed single- and double-walled ampoules are shown in Figs. 11(a) and 1(b). In both ampoules, there is a 3–4 mm opening at the top through which the charge can be filled. The ampoules were made of high-quality glass of thickness 1.5 mm. The inner diameters of the single- and double-walled ampoules are about 14 and 18 mm, respectively. The angle at the bottom of the conically shaped inner wall is about 30 deg, the conical length is 5–7 mm and the double-wall thickness in the conical region is about 1–2 mm. This design helps in restricting spurious nucleations that may be entering from the outer wall and allows only one nucleation to initialize the growth. The conical end of the outer wall normally encourages the initiation of fine nucleation. The double-wall ampoule helps us to avoid thermal fluctuation during and after growth, and the vacuum inside the growth ampoule also acts as a thermal insulator to ensure good quality single crystals as observed by HRXRD. The improved crystalline perfection was found enhance the optical properties. This study reveals that the present VBT growth method with a double-wall ampoule is effective for growing good quality single crystals of BMZ-like low-melting-point organic crystals.

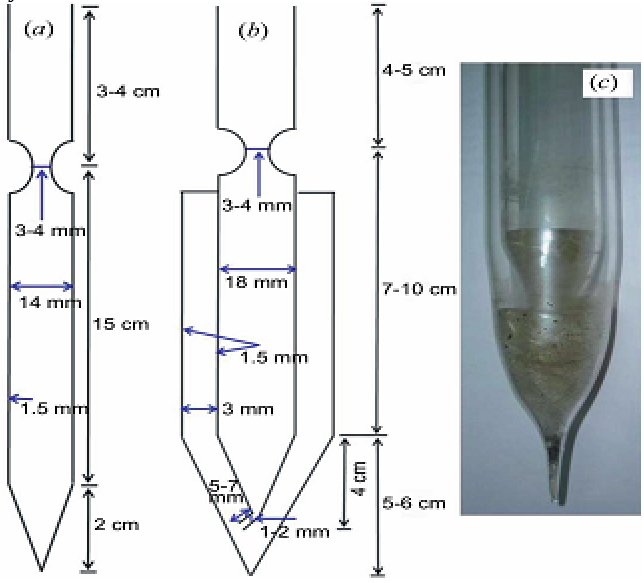

Figure 11: Schematics of the ampoules: (a) single wall and (b) double wall. (c) A double-wallgrown BMZ single crystal within the ampoule.

3 Conclusions

Depending upon the nature of the material and the growth technique one can adopt various in situ/after growth processing methods to improve the crystalline perfection of the bulk single crystals and thereby one can improve the device characteristic parameters needed for the advanced technological applications.

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