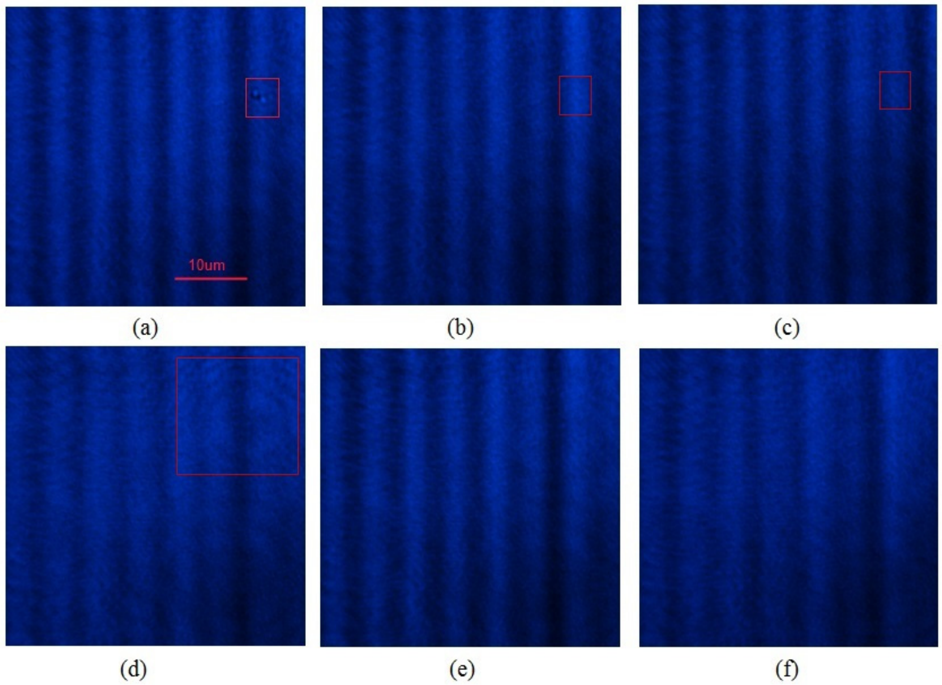

Fig. 4. Integer and fractional QPM SH Talbot self-imaging. (a) is the SH pattern at the end face of the sample. The marked area is a defect in the sample. (b) and (c) are the SH self-images at the first and second Talbot planes, respectively. The marked areas corresponds to the same position of the defects in (a). (d)-(f) are the fractional SH self-image at a distance of 29.1um, 63um, and 84um away from the sample, respectively. The marked area in (d) present a fine structure due to the defect in (a).

4. Conclusion

In conclusion, we have experimentally demonstrated the QPM SH Talbot effect in a squarely-poled $LiTaO_3$ crystal. The collinear SHG is phase-matched with the use of a reciprocal vector in the domain structure. Also, the SHG process produces a periodic SH pattern at the end face of the crystal, which originates from the periodic domain structure along the lateral direction in the crystal. The QPM SH Talbot effect can be then observed in the Fresnel near-field. The introduction of QPM can efficiently convert the fundamental wave into the SH wave. As a result, the intensity of the SH Talbot self-imaging are enhanced by a factor of 21 through the QPM technique. These improvements make it more practical to apply nonlinear Talbot self-imaging in lithography, array illuminator and imaging process.

Acknowledgments

This work was supported by the National Basic Research Program of China (Nos. 2012CB921804 and 2011CBA00205), the National Science Foundation of China (Nos. 11274162, 61222503, 11274165 and 11004097), the New Century Excellent Talents in University and the Specialized Research Fund for the Doctoral Program of Higher Education (No. 20100091120010). The authors thank Jianming Wen for useful discussions.