# Development of new X-ray diffraction enhanced imaging system using channel-cut crystals

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**Abstract:**

X-ray Phase contrast imaging is now a powerful tool to identify the tiny electronic-density difference in a subject. However diffraction enhanced imaging (DEI), which is widely utilizing in many research fields, has a limitation to analyze the extremely tiny electronic-density difference such as inside the soft tissue. We have proposed multiple-times-diffraction enhanced imaging (M-DEI) system to improve the density resolution of a DEI image. M-DEI system is using a multiple-diffraction Bragg-type analyzer, which is a key point of the imaging system, to get a specific rocking curve to improve the density resolution.

The multiple-times-diffraction means: in contrast to laser scanning systems, where only a single point is illuminated at once, the time-of-flight cameras illuminate a whole scene. Due to multiple-times-diffraction, the light may reach the objects along several paths and therefore, the measured distance may be greater than the true distance. If the density of the diffraction after the 1-times diffraction called R, then the density of the diffraction after the $n^{th}$ reflection will be $R^n$. As Fig.1 and Fig.2 shows, the density distribution after the 1-times diffraction and n-times diffraction called rocking curve. The magnitude of moving down after n-times diffraction is lower than the one after 1-times diffraction when the analyzer rotating. Under the same angle of rotation, the higher contrast will be taken on. As the Fig.1 showed that under the same rotation angle, the 1-times diffraction generate the gradient A, the 7-times diffraction generate the gradient B. It is obvious that B is higher than A by two order of magnitude. The Fig.2 shows the rotation angle change under the same gradient L. The 1-times diffraction generate the rotation angle $\theta_1$, the 3-times diffraction generate the rotation angle $\theta_2$. Where $\theta_1$ is less than $\theta_2$. Depend on the variation of rocking curve, which is logical to associate with visualization in thinking the application.

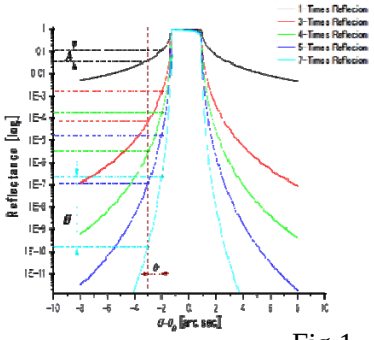


Fig.1

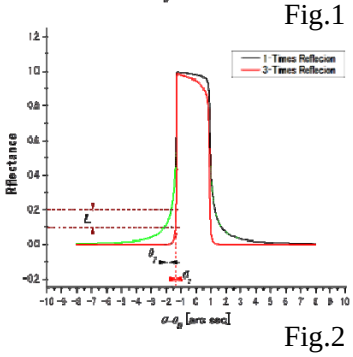


Fig.2

**References:**

[1] D. Chapman, W. Thomlinson, R. E. Johnston, D. Washburn, E. Pisano, N. Gmür, Z. Zhong,

R. Menk, F. Arfelli and D. Sayer; Diffraction enhanced x-ray imaging, Phys. Med. Biol. 42 2015–25 (1997)

[2] U. Bonse and M. Hart: Tailless X-ray single-crystal reflection curves obtained by multiple reflection, Appl. Phys. Letters. 7, 238 (1965)