

IMPROVED RECORDING SYSTEM FOR THE STUDY OF SINGLE CRYSTAL IMAGING SCREENS

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The progressive image recording system in transmission electron microscope (TEM) is the setup utilising the YAG:Ce single crystal imaging screen, a light optical device, and some recording unit enabling processing the resulting image using a personal computer (PC) [1]. For such an arrangement, the key role relates to the screen, that has to provide an image with minimum imperfections to obtain an acceptable result after the final magnification. Therefore, imaging capability, i.e. spatial resolution, striations, and other defects of single crystal screens must be studied very carefully.

Old system

Previously, the experimental setup (Fig. 1a) for investigation of YAG:Ce single crystal screens properties was used in our laboratory [2]. Using the Philips CM 12 TEM and the arrangement shown, the spatial resolution was measured by edge projection on to the examined screen. The modulation transfer function (MTF) was obtained with use of the Fourier transform of the edge spreading. To obtain precise MTFs even for the spatial frequencies higher than 150 mm^{-1} (primary beam less than 20 keV), one must magnify image from the screen as high as possible. The neck of the previous optical equipment with two prisms resided not only in the poor magnification, but also in the imperfectly fixed optical system, which was able to correct the defocussing of the system only hardly. Although the classical camera was used for initial experiments, it was an uncomfortable, but not limiting element.

New system

The goal of the new design (Fig. 1b) is on-line processing of very small image from a single crystal screen without the loss of details. To accomplish these requirements, the CCD camera has been applied, and the initial robust recording system has been replaced by a new relatively small and precisely machined device (Fig. 2). The image created on the screen is magnified by small Olympus S Plan objectives, and it is recorded with use of a high resolution CCD camera and a frame grabber plugged in the PC. The objectives are situated in the four-position lens turret, and so the magnification is changeable very easily. The objectives and the CCD are jointed very rigidly, therefore the focussing of the recording system can be accomplished readily by the fine adjustment element.

The investigated screen is positioned in the bayonet joint cartridge at an otherwise heavily accessible TEM chamber, which makes possible quick, simple and safe exchange of an examined screen. The cartridge is equipped with the tilt mechanism, to ensure perfect perpendicular screen orientation towards the optical axis. The recording

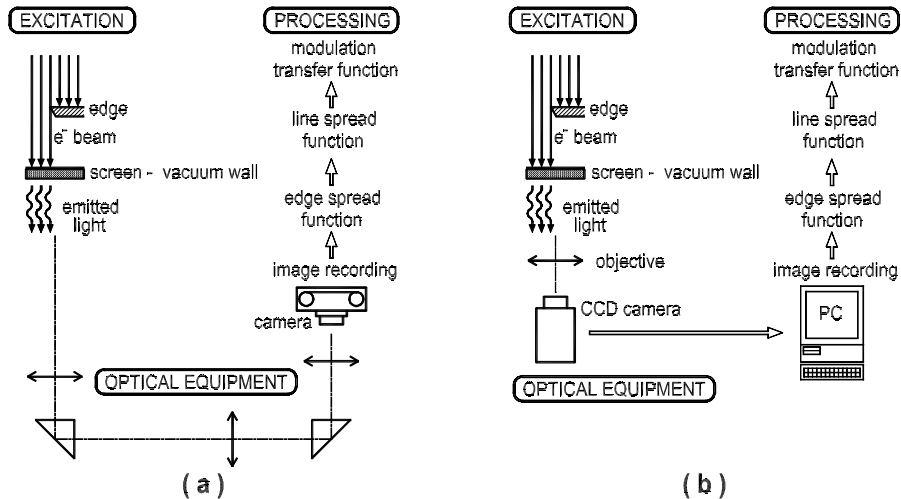


Figure 1. Arrangements for the study of single crystal screen properties. The silicon single crystal plate with the anisotropically etched hole is used as an projection object, and the YAG:Ce single crystal disk as an imaging screen. **(a)** Standard setup utilising the objective-eyepiece system with two prisms. **(b)** Improved setup utilising the Olympus S Plan Apo objective and a high resolution CCD camera.

system is equipped with the x-y manipulator, which makes possible selection of observed objects, and/or moving the objective system out for the screen replacement.

In the first processing step, the image digitised in the PC by the Matrix Vision Pimage-SC frame grabber card is formed, and the edge spread function can be obtained using the Tescan Atlas image processing software. In the next step, the MTF of the edge response in the screen can be obtained from the modulus of the Fourier transform of the line spread function. The MTF is the best diagram for the screen spatial resolution determination.

Acknowledgement

The authors thank Professor Armin Delong for his assistance with the optical equipment designing. This work was supported by the grant No. 202/01/0518 of the Grant Agency of the Czech Republic.

References

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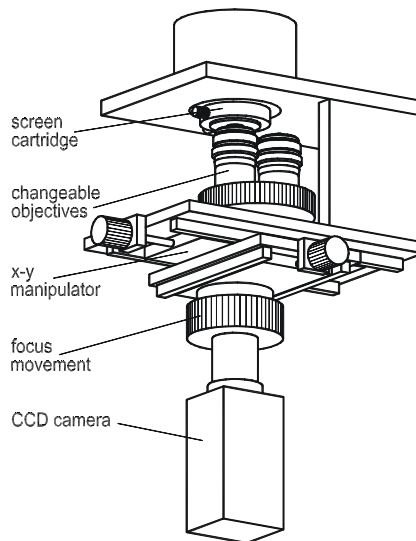


Figure 2. The drawing of the new recording system. After adjusting and focussing, the image from the screen, magnified by the Olympus S Plan objective, can be recorded by a high resolution CCD camera.