The modified Williamson-Hall plot, revisited

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The modified Williamson-Hall (mWH) plot [1] is a popular method for the analysis of the coherent domain size and dislocation density of plastically deformed crystals. Contrary to its original formulation, stating that the peak breadth depends on the dislocation arrangement parameter M, there is a tendency in the literature for using the mWH-plot alone, without accounting for this effect.

Based on numerical simulation of diffraction peaks for different dislocation arrangements we verify the validity of the mWH-plot (Fig. 1) and we derive an empirical relation between M and the peak width. It is shown that the main arrangement parameter affecting broadening is the correlation between the Burgers vector signs, and spatial correlations play only a secondary role.

In order to determine dislocation density from the mWH-plot the M parameter has to be known, which is possible only from the Fourier analysis of the peak profile. The latter method, which is based on the mathematical form of the strain filed close to dislocations and therefore is independent on dislocation distribution, should be the preferred procedure for the evaluation of the dislocation density.

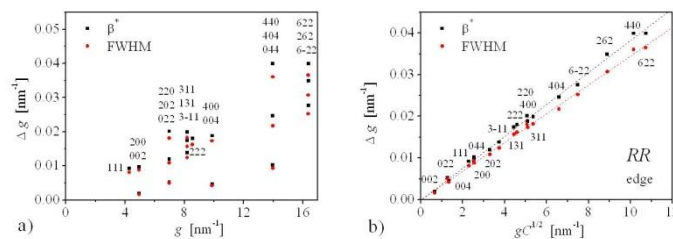*Keywords: X-ray Peak Profile, dislocation density, numerical simulation*

Fig.1 WH and mWH-plots of the peak widths corresponding to an ensemble of edge dislocations

References:

[1] T. Ungár, A. Borbély, The effect of dislocation contrast on x-ray line broadening: a new approach to line profile analysis, Appl. Phys. Lett. 69 (1996) 3173–3175.